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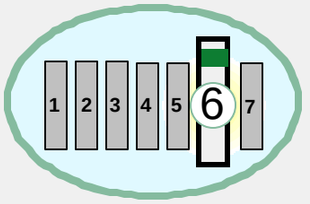
Hazardous Waste Combustion Unit Permitting Manual



COMPONENT 6

How To Review A Trial Burn Report

U.S. EPA Region 6 Center for Combustion Science and Engineering

Tetra Tech EM Inc.

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COMPONENT SIX

HOW TO REVIEW A TRIAL BURN REPORT

JANUARY 1998

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B	HOW TO REVIEW A TRIAL BURN REPORT CHECKLIST
C	STACK GAS EMISSION CALCULATIONS

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ABBREVIATIONS AND ACRONYMS

AA	Atomic adsorption
acfm	Actual cubic feet per minute
APCS	Air pollution control system
ASTM	American Society for Testing and Materials
AWFCO	Automatic waste feed cutoff
BIF	Boiler and industrial furnace
Btu	British thermal unit
Btu/lb	British thermal units per pound
Btu/hr	British thermal units per hour
CAA	Clean Air Act
CEMS	Continuous emissions monitoring system
40 CFR	Title 40, Code of Federal Regulations
Cl_2	Chlorine gas
CO	Carbon monoxide
CO_2	Carbon dioxide
COC	Chain of custody
COPC	Constituent of potential concern
DC	Direct current
DRE	Destruction and removal efficiency
dscf	Dry standard cubic feet
dscfm	Dry standard cubic feet per minute
dscm	Dry standard cubic meter
ESP	Electrostatic precipitator
°F	Degrees Fahrenheit
FID	Flame ionization detector
40 CFR	Title 40, Code of Federal Regulations
ft^3	Cubic feet
ft^3/hr	Cubic feet per hour
g/sec	Grams per second
GC	Gas chromatography
gph	Gallons per hour
gpm	Gallons per minute
gr/dscf	Grains per dry standard cubic foot
g/dscm	Grams per dry standard cubic meter
GRAV	Gravimetrically
H_2O	Water
HCl	Hydrogen chloride
HHV	High heating value
HRA	Hourly rolling average
ICP	Inductively coupled plasma
IWS	Ionizing wet scrubber
kg/hr	Kilograms per hour
kVA	Kilovolt Ampere
L	Liter
lb	Pound

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lb/min	Pound per minute

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ABBREVIATIONS AND ACRONYMS (Continued)

lb/hr	Pound per hour
LHV	Low heating value
m^3/hr	Cubic meters per hour
min	Minute
MMBtu	Million British thermal units
MS	Mass spectrometry
N_2	Nitrogen
ng/m^3	Nanograms per cubic meter
O_2	Oxygen
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear aromatic hydrocarbon
PCC	Primary combustion chamber
PCDD/PCDF	Polychlorinated dibenzopdioxin/polychlorinated dibenzofuran
PIC	Product of incomplete combustion
PM	Particulate matter
POHC	Principal organic hazardous constituent
ppm	Parts per million
ppmv	Parts per million by volume
PQL	Practical quantitation limit
PSD	Particle size distribution
psi	Pounds per square inch
psig	Pounds per square inch
PST	Performance specification test
QAPP	Quality assurance project plan
QA/QC	Quality assurance/quality control
RBP	Risk burn plan
RBR	Risk burn report
RCRA	Resource Conservation and Recovery Act
SCC	Secondary combustion chamber
scfm	Standard cubic feet per minute
SQL	Sample quantitation limit
STP	Standard temperature and pressure
SVOC	Semivolatile organic compound
TBP	Trial burn plan
TBR	Trial burn report
TCO	Total chromatographicable organics
THC	Total hydrocarbon
TO	Total organics
U.S. EPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
VOST	Volatile organic sampling train
WAP	Waste analysis plan
w.c.	Water column
μg	Microgram
μg/dscm	Microgram per dry standard cubic meter

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$\triangle H$	Orifice meter differential
$\triangle P$	Differential pressure

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1.0 OVERVIEW OF TRIAL BURN REPORT REVIEW

Regulations: No regulations are applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: The trial burn report (TBR) is a comprehensive document that (1) includes copies of the trial burn plan (TBP) and trial burn quality assurance project plan (QAPP); (2) completely summarizes all activities associated with the trial burn test; (3) includes all supporting information needed to document the results of the trial burn test; and (4) serves as the basis for the development of permit conditions, discussed further in Component 7—How to Prepare Permit Conditions. The TBR may be referred to as a risk burn report (RBR) if it summarizes activities associated with risk burn testing. In this component, TBR and RBR can be used interchangeably in most cases. Specific instances where a TBR and RBR differ are highlighted

Attachment A is the U.S. Environmental Protection Agency (EPA) 1994 "Memorandum on Trial Burns," also referred to as "Guidance on Trial Burn Failures." This memorandum offers guidance on evaluating the success or failure of trial burns. Attachment B is a review checklist the TBR review team leader can use to ensure that all sections of this component have been considered. Attachment C includes spreadsheets (both in hard copy printout and on diskette) that calculate stack gas emissions using trial burn stack sampling and laboratory analytical data.

Check For: The TBR should include the following major elements. These elements are discussed in more detail in the subsections of this component identified below:

- ❑ Executive summary (see Section 3.0)
- ❑ Introduction (see Section 4.0)
- ❑ Process description (see Section 5.0)
- ❑ Testing program overview (see Section 6.0)
- ❑ Test operating conditions (see Section 7.0)
- ❑ Process and stack gas sampling (see Section 8.0)
- ❑ Laboratory procedures (see Section 9.0)
- ❑ Quality assurance/quality control (QA/QC) results (see Section 10.0)
- ❑ Trial burn results summary and proposed permit limits (see Section 11.0)

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- ❑ Appendices
    - ❑ TBP and trial burn QAPP (see Sections 12.1 and 12.2)
    - ❑ Stack sampling report (see Section 12.3)
    - ❑ Process sampling report (see Section 12.4)
    - ❑ QA/QC report (see Section 12.5)
    - ❑ Instrument calibration records (see Section 12.6)
    - ❑ Performance calculations (see Section 12.7)
    - ❑ Field logs (see Section 12.8)
    - ❑ Analytical data packages (see Section 12.9)

As discussed in Sections 1.2 and 1.3 of this component, the TBR is typically reviewed by a team of experts. During review of these sections, the TBR review team should check for the following:

- ❑ Verification that the trial burn test was conducted in accordance with the approved TBP and trial burn QAPP
- ❑ Verification that information included as appendices and attachments to the TBR support the data summaries and conclusions presented in the main body of the text
- ❑ Verification that the report draws appropriate conclusions on the basis of information collected during the trial burn test and risk burn test for the following:
    - ❑ Combustion unit operation
    - ❑ Appropriate feed rates
    - ❑ Representative emission rates
    - ❑ Supportable risk assessment results
- ❑ Verification that proposed permit conditions are supported by data summaries

Example Reports: TBRs are prepared for numerous types of tests, may be referred to by different titles, and can serve several different purposes. For example, a TBR may be prepared for:

- Trial burn test report
- Demonstration test report
- Risk burn test report
- Emissions evaluation verification report
- Certification of compliance test report

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These reports can serve many different purposes, including:

- Establishing a comprehensive list of permit limits for a new combustion unit
- Collecting information on the emission rates of constituents of potential concern (COPC) under normal operating conditions
- Providing the information needed to establish an automatic waste feed cutoff (AWFCO) limitation

Example Concerns for the Reviewer:

Before beginning, the reviewer should understand why the facility has submitted the TBR, including at least a cursory understanding of: (1) the permitting process history leading to the trial burn review, (2) the concerns and objectives of other key personnel involved in the permitting process, and (3) any concerns identified during the trial burn test (typically identified in the field oversight report, see Component 4— How to Conduct Trial Burn Test Oversight).

This level of understanding will enable each member of the TBR review team to (1) complete his or her task with the necessary level of accuracy, and (2) prepare comments that are effective and constructive. This is especially true of staff who become part of the TBR review team because of a new position or their particular expertise, but who have not been part of the ongoing review and approval process for the TBP and trial burn QAPP before this point. The combustion unit permitting process typically requires several years. Because of the effort involved—after the TBP and QAPP have been negotiated and approved—see Component 1—How to Review a Trial Burn Plan and Component 2—How to Review a Trial Burn Quality Assurance Project Plan—the ultimate objective of everyone involved in the process should be to ensure the following:

- Successful trial burn test
- Well-written and documented TBR
- Permit conditions that protect human health and the environment

All members of the TBR review team must understand:

- The significance of each issue identified
- Effective strategies for preparing comments and collecting additional information from the facility

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Notes:

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1.1 RECOMMENDED REPORT FORMAT

Regulations: Title 40 Code of Federal Reputations (40 CFR) Part 270.62(b)(6) through (9)
40 CFR Part 270.66(d)(3), (4), and (5)

Guidance: No specific references are applicable to this section of the manual.

Explanation: A thorough Executive Summary presentation is the foundation for an effective TBR review process. In the Executive Summary, the facility submitting the TBR should present a brief presentation of the results concerning compliance issues. A brief statement should explain if the data met the criteria specified in the QAPP. The Executive Summary should also serve as a platform to introduce problems and deviations that occurred or were identified. This information will help the reviewer understand all major aspects of the TBR and prepare them to conduct a comprehensive and efficient review. The TBR format should include the sections identified in Section 1.0 of this component.

Check For:

- ❑ Executive Summary
- ❑ List of key project personnel in the Introduction
- ❑ Whether the TBR format follows the approved TBP
- ❑ Comparison of test conditions to planned conditions
- ❑ Detailed chemical and physical analysis of waste and process samples
- ❑ Stack gas analysis for pollutants as planned, and emission rate calculations for all pollutants
- ❑ QA/QC discussion for all analytical results
- ❑ Whether correct appendices are attached
- ❑ Discussion of problems, delays, or changes from the approved TBP
- ❑ Field data sheets
- ❑ Emission rate calculations
- ❑ Equipment calibration reports
- ❑ Continuous emission monitoring system (CEMS) calibration and performance specification test (PST) results
- ❑ Process data

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- ❑ Problems and deviations, especially those affecting QA/QC

Example Situation: Lois and Clark were selected for the review of various TBRs. As Lois and Clark started to review the TBR for the XYZ Company hazardous waste incinerator, they noted that there was no Executive Summary. The lack of an Executive Summary created instant review problems because a thorough report presents all regulatory results in this summary section.

Continuing their review, Lois and Clark found that the report did not reference the TBP or compare planned activities to actual activities. Also, with no cross-referencing, it was necessary for Lois and Clark to review the hazardous waste analysis, the principal organic hazardous constituents (POHC) that were selected, and their concentrations in the waste streams. As a result, the TBR review process was delayed repeatedly.

Finally, Lois and Clark noticed that the TBR lacked appendices presenting field data and emission rate calculations, the QA/QC report, calibration reports, or other information needed for a comprehensive technical review.

In sum, Clark found that the TBR was deficient in many areas. The TBR appeared to have been prepared with no understanding of data management, continuity, or results presentation.

Example Action: After several attempts to obtain a correct and complete version of the TBR failed, Clark issued an Administrative Order to the company to resubmit the TBR with all required information and data. He further informed the company that it could not operate at its proposed permit limits until a complete and comprehensive report was reviewed and approved. The company was ordered to operate at 85 percent of planned limits and was told that an oversight contractor for the U.S. EPA would audit the facility every 10 days until the report was approved, and that the company would be required to pay oversight costs.

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1.2 ASSEMBLING THE REVIEW TEAM

Regulations: No regulations are applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: Because there is a wide variety of information presented in a TBR, several disciplines working as a team are required to review a TBR. The official assigned the responsibility as permit writer should be the team leader. The following are suggested team members:

- *Permit writer*
  Team leader; should be familiar with the regulations, the technology, and the facility compliance record

- *Chemist*
  Should be familiar with approved analytical methods, QA/QC procedures, and sampling techniques

- *Mechanical or chemical engineer*
  Should have experience with combustion technology, burner design, principles of combustion, refractory types, air pollution control system (APCS) operation and limitations, waste types and combustion requirements, and field experience with combustion unit operation

- *QA/QC control officer*
  Should be familiar with U.S. EPA QA/QC requirements for waste analysis, process sample analysis, and stack gas pollutant analysis. Can also contribute to blank, spike, and surrogate analysis acceptance criteria, and check analytical calculations for accuracy

- *Toxicologist or risk assessor*
  Should be familiar with risk assessment protocols and procedures as applied to hazardous waste combustion units. This team member would be responsible for reviewing the risk assessment results submitted as an addendum to the TBR

- Others, as special needs become known, who can be available to help as needed

Check For: For each of the key members listed above, the following information should be evaluated:

- ❑ Team member credentials

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- ❑ Team member availability
- ❑ Team leader assignment
- ❑ Schedule and meeting review
- ❑ Potential conflicts of interest with team members or outside consultants

Example Situation: Lois and Clark were reviewing the memorandum assigning personnel responsibility for review of various TBR sections for the XYZ Company combustion unit. During the review, Lois noticed that John Doe (chemical engineer) had been a former employee of the parent company of XYZ. Lois knew this assignment could present a perceived conflict of interest.

Example Action: Lois prepared a memorandum strongly suggesting that a different engineer be responsible for reviewing the engineering aspects of the XYZ combustion unit.

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1.3 DIVIDING THE DOCUMENT

Regulations: No regulations are applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: TBRs are usually submitted to the permitting agency in several volumes. The main volume, usually Volume I, contains the Executive Summary and Introduction. The remaining volumes usually contain field data sheets for process sampling, stack sampling, and traceability. Other volumes contain analytical data and QA/QC results, in addition to gas chromatography/mass spectroscopy (GC/MS) data. Some reports include appendices containing copies of the analytical method, usually for various stack gas sampling methods and analysis for volatiles, semivolatiles, polychlorinated dibenzo-p-dioxins/ polychlorinated dibenzofurans (PCDD/PCDF), metals, and other analytes.

After selecting all team members, the team leader should assemble the entire review team and divide the submittal among team members. The submittal will be divided based on areas of expertise. The team leader should establish a sign-out sheet for each part of the report assigned to a team member.

Next, the team leader should specify due dates for return of the document and the review comments. Each team member should clearly understand his or her responsibility and the date the review is due.

Check For: Before meeting with the team, the team leader should check to confirm that all volumes of the TBR have been received. Then, the individual section headings should be checked against the list in Section 1.0 of this component to confirm that all major sections are discussed.

Example Situation: Lois and Clark were reviewing the Executive Summary for the XYZ Company combustion unit trial burn report and noticed that the POHC destruction and removal efficiency (DRE) was 99.99 percent for test Condition 2, Run 2. This result seemed odd, because all other POHC DREs were calculated out to six decimal places. Lois checked the TBR for Condition 2, Run 2 analytical results and found the POHC DRE calculated out to 99.9869 percent. The contractor has rounded up to 99.99 percent in the Executive Summary. Lois reviewed U.S. EPA's Guidance on Trial Burn Failures and developed a recommendation for senior management based on the guidance policy and the facts of the case.

Example Action: Because the POHC DRE had failed the established criteria for passing, and U.S. EPA specifically prohibits rounding up for POHC DRE, Lois notified senior management of this significant issue before dividing the report and completing the detailed review. After completing the review of the entire report, Lois noted her comments that test Condition 2 was invalid.

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2.0 REVIEWING GENERAL REPORT CONTENTS

Regulations: 40 CFR Part 266.103
40 CFR Parts 270.62(b)(6) to 270.62 (b)(9)

Guidance: No specific references are applicable to this section of the manual.

Explanation: A TBR is a comprehensive document that provides the reviewer an overview of the facility and general operations. It may present some of the same information contained in the TBP. It should contain an Executive Summary that presents the results of the trial burn as briefly as possible. In general, a TBR contains specific sections with appendices for data and process information. The following "Check For" items comprise a general list of a TBR; there will be variations for different combustion units.

Check For:

- ❑ Table of contents
- ❑ Certification form
- ❑ Appropriate sections (see list in Section 1.3 of this component)
- ❑ Appendices

Example Report: Generally, the TBR is formatted parallel to the TBP to facilitate report review. An approved copy of the TBP, which is typically included as an attachment to the TBR, should be consulted during TBR review. One of the most commonly omitted sections of the report is a certification, signed by a corporate officer or other authorized agent of the facility, certifying that the trial burn has been conducted in accordance with the approved TBP. Exhibit 2.0-1, see page 6-12, is an example certification.

Example Concerns for the Reviewer: It is rare that any major section of the report is omitted. Continuing with the review process or writing a comment on this type of issue wastes time and delays the permitting process. If a section is missing, the agency should decide appropriate action before contacting the facility.

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EXHIBIT 2.0-1

EXAMPLE TRIAL BURN TEST CERTIFICATION

Certification

I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision, in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. Furthermore, to the best of my knowledge, the trial burn was conducted in accordance with the approved Trial Burn Plan, except as noted in this document. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for violations.

Sam Pultaker
XYZ Stack Sampling Company

Date

John Q. Citizen
Big Chemical Company

Date

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3.0 REVIEWING THE EXECUTIVE SUMMARY

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The Executive Summary of the TBR should summarize the results of the trial burn conducted for the facility. This section also briefly describes key process system parameters and the results of the trial burn. It is important to note, however, that any data presented in the Executive Summary should be thoroughly evaluated when reviewing later sections of the TBR. It is common that data summarized in the Executive Summary are not as detailed or accurate as data presented in specific sections of the TBR.

It is suggested that the summary information be presented in table form. This format facilitates locating information. In addition, clear references should be provided to other sections of the TBR when supporting information can be found. It is also recommended that a separate table be provided that identifies the trial burn data input into the risk assessment.

Check For:

- ❑ Summary of stack gas parameters and emission rate results (see Section 3.1)
- ❑ Key process system parameters and results (see Section 3.2)
- ❑ Problems encountered during the trial burn test, solutions, and deviations from the approved TBP (see Section 3.3)
- ❑ Conclusions on the success in meeting TBP objectives (see Section 3.4)

Example Situation: While Clark was examining a table in the Executive Summary presenting stack gas parameters, he noticed that the stack temperature was reported as 1,200°R. The reported result was suspect, because he noticed that (1) the exhaust gas stream did not pass through any control device or waste heat recovery unit, and (2) the combustion chamber temperature was about 1,700°R. Clark turned to the stack testing raw data forms in the appendix and discovered that the stack gas temperature was recorded at about 1,200°F. It was obvious that the readings were not converted from°F to°R, as presented in the Executive Summary.

Example Action: During the TBR review, it became evident to Clark that numerous data were collected, numerous forms were completed, and numerous calculations and numbers were reduced before presentation in the Executive Summary. In most cases, it is worthwhile to begin the review from the appendix sections, follow raw data reduction to calculations, and then verify reported results and associated units before examining a summary of numbers.

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3.1 REVIEWING THE SUMMARY PRESENTATION OF STACK GAS PARAMETERS AND EMISSION RATE RESULTS

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The Executive Summary section of the TBR should summarize stack gas parameters and emission rate results.

Check For: The results discussed in the Executive Summary should be verified for accuracy and consistency with the rest of the TBR data and results. At a minimum, check for the following:

- ❑ Whether the stack gas volumetric flow rate, corrected to dry standard conditions, is presented
- ❑ Whether test results represent the average of all runs conducted under a specific test condition
- ❑ Whether carbon monoxide (CO) concentration is reported on the basis of dry parts per million by volume (ppmv), and corrected to 7 percent oxygen (O_2)
- ❑ Whether the POHC DRE is accurate to at least four significant digits (that is, 99.99 percent)
- ❑ Whether all results are presented as numerical values (neither not detectable nor "nondetect" is an acceptable result)
- ❑ Whether the O_2 concentration is reported on the basis of dry units of volume percent
- ❑ Whether the hydrogen chloride (HCl) emission rate is presented in pounds per hour (lb/hr)
- ❑ Whether all pollutants are presented on the basis of dry units
- ❑ Whether the particulate matter (PM) concentration is presented in grains per dry standard cubic feet (gr/dscf) at 7 percent O_2
- ❑ Whether detection limits are reported along with emissions data and identified as to the type of detection limit (for example, practical quantitation limit [PQL] or sample quantitation limit [SQL])
- ❑ Whether emissions data are presented in grams per second (g/sec) for input into the risk assessment

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- ❑ Whether any emission rates are adjusted for input into the risk assessment and, if so, justification and data supporting the adjustment (for example, using half the detection limit).

Example Situation: Clark noticed the following statement presented in a TBR, "Because Compound X was not detected by the laboratory, the mass emission rate is 0 pounds per hour."

Example Comments: Clark informed the company that if a compound is not detected by an analytical method, the detection limit value should be used for all ensuing calculations. Place a "<" (less than) symbol in front of the value, complete the calculations, and report the result as a "<" value.

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3.2 REVIEWING THE SUMMARY OF KEY PROCESS SYSTEM PARAMETERS AND RESULTS

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The Executive Summary section of the TBR may be used to summarize key process system parameters and results because this information will be used to establish operating limits. It is not necessary that the items under "Check For" be included in the Executive Summary section, as long as they are included elsewhere in the TBR.

Check For:

- ❑ Whether average, minimum, and maximum combustion zone temperatures are presented
- ❑ Whether waste feed stream and ancillary fuel mass flow rates are presented
- ❑ Whether excess O_2 concentration is presented for all test runs

Example Situation: In reviewing the TBR Executive Summary, Lois noted that the excess O_2 concentration in the flue gas stream measured by boiler and industrial furnace (BIF) operations was significantly different from that recorded by the stack sampling contractor. Typically, O_2 concentration measured by testing companies is reported on a dry basis. Process equipment mounted on an exhaust stack usually measures O_2 concentration on a wet basis. Measurements can be compared only when both readings are on a consistent basis.

Example Comments: Lois quickly refers to the applicable section of the TBR and makes a note to check for that specific issue in the text. The Executive Summary has successfully informed Lois and prepared her for the detailed review of specific issues in the body of the report.

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3.3 REVIEWING THE SUMMARY OF PROBLEMS, SOLUTIONS, AND DEVIATIONS FROM THE TRIAL BURN PLAN

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The Executive Summary section of the TBR should review any problems encountered during the trial burn test, their solution, and any deviations from the TBP. This summary is important, because the permit writers may not have reviewed the TBP and QAPP. In addition, they may not be familiar with the process, sampling and analytical methodologies associated with field decisions, or the ramifications of altering the planned testing of objectives.

Check For:

- ❑ Any notation that alternative stack sampling procedures were used
- ❑ Any notation that alternative laboratory procedures were used
- ❑ All deviations from the proposed process operating conditions
- ❑ Reduced performance and efficiency from ancillary equipment or control devices
- ❑ Changes in the targeted POHC

Example Situation: Lois reviewed (1) the Executive Summary of problems, solutions, and deviations; and (2) the TBR and appendices. Lois notes that the facility developed a test and QA/QC plan to incinerate carbon tetrachloride to demonstrate a DRE of 99.99 percent. A subcontractor was hired to provide spiking materials, and the entire project was scheduled to accommodate all parties involved in the trial burn test. At the conclusion of the trial burn test, it was discovered that the POHC spike was monochlorobenzene rather than carbon tetrachloride.

Example Action: Because of the potentially serious implications of this issue, Lois dedicates a significant amount of time during her review determining whether the trial burn test results can be salvaged for the use in developing permit limits. She notes that the POHC DRE of monochlorobenzene was 99.99 percent—and because monochlorobenzene is more difficult to incinerate than carbon tetrachloride—Lois was able to recommend that the facility be permitted to operate at test conditions demonstrated. Luckily, the regulatory agency was able to issue a permit in spite of this significant deviation from the approved TBP.

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3.4 REVIEWING CONCLUSIONS

Regulations: 40 CFR Part 266.102
40 CFR Parts 266.104 to 266.107

Guidance: No specific references are applicable to this section of the manual.

Explanation: The Executive Summary section of the TBR should present conclusions about the success of the trial burn test in meeting test objectives. The objectives outlined in the TBP are initially identified so that test results can be used to establish permit and operating conditions.

Check For:

- ❑ Whether the POHC DRE was at least 99.99 percent
- ❑ Whether the CO concentration, corrected to 7 percent O_2, was less than 100 ppmv
- ❑ Whether the HCl emission rate was less than or equal to 4 lb/hr and within acceptable risk based limits
- ❑ Whether the PM concentration was less than 0.08 gr/dscf at 7 percent O_2
- ❑ Whether metals emission rates were within the allowable Tier limit and within acceptable risk-based limits
- ❑ Whether organic compound emissions (for example, products of incomplete combustion [PIC] such as PCDDs and PCDFs) were within acceptable risk-based limits
- ❑ Whether emissions met all applicable air permit conditions

Example Situation: In reviewing the Executive Summary conclusions, Lois notes that the average results from a trial burn test were reported as follows:

- DRE = 99.999 percent
- CO = 2.4 ppmv at 7 percent O_2
- HCl = 3.7 lb/hr
- PM = 0.042 gr/dscf at 7 percent O_2

Example Action: Lois compared these results in the Executive Summary to all data results provided in the TBR and compared the results to the standards presented in 40 CFR Parts 266.104 to 266.107. Based on her review, Lois quickly determined that all of these results are within compliance limitations.

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4.0 REVIEWING CHAPTER 1—INTRODUCTION

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section provides introductory information to the trial burn conducted for the facility. Generally, it includes facility background information; facility name, address, and location; test date and times; who conducted the test; why the test was conducted; and the report format.

This section should typically present no new information about the facility. This section can be checked quickly by comparing it to the same set of information presented in the TBP (typically included as Appendix A of a TBR) or the information collected during the trial burn test (presented in the oversight report, see Component 4—How to Conduct Trial Burn Test Oversight).

Check For:

- ❑ Background information
  - ❑ Facility name
  - ❑ Contact
  - ❑ Address
  - ❑ Telephone number
  - ❑ U.S. EPA identification number
  - ❑ U.S. EPA region
- ❑ Person responsible for TBR
  - ❑ Company name
  - ❑ Address
  - ❑ Telephone number
  - ❑ Date
- ❑ Person responsible for QA/QC
  - ❑ Title
  - ❑ Address
  - ❑ Telephone number
- ❑ Why the test was conducted
- ❑ Person conducting the test and project participants
- ❑ Dates and times of the test

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Example Situation: In reviewing the TBR, Clark reads the following information:

"This report documents the results of the trial burn conducted on Boiler A1 at XYZ Chemical, Inc., U.S. EPA Identification No. LAD100101231, located in ABC Parish, Louisiana."

However, Clark noted that the TBP (Appendix A) contained the following information:

"This trial burn plan is prepared for Boiler A2 at XYZ Chemical Inc., U.S. EPA Identification No. LAD100101321, located in ABC Parish, Louisiana."

Example Action: To determine whether the test was conducted on Boiler No. A1 or A2, Clark reviewed other supporting documents (including the field data log sheet and operation records). To resolve the discrepancy between identification numbers, Clark reviewed the trial burn test oversight report.

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5.0 REVIEWING CHAPTER 2—PROCESS DESCRIPTION

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA/625/6-89/019. Chapter 5, Appendix B, and Appendix F.

Explanation: A process description, including process design information, a summary of process monitors and stack gas analyzers, and a schematic with process monitoring points is generally included in the TBR. If the TBR does not include any of these items, the TBP (typically included as Appendix A to the TBR) should be reviewed for any missing information. The trial burn test oversight report (see Component 4—How to Conduct Trial Burn Test Oversight) should also be reviewed to gather this information. The trial burn test oversight may sometimes contain more detailed, or the latest, information for various parameters. Exhibits 5.0-1 through 5.0-3, see pages 6-24 through 6-27 are examples of the type of information that may be presented in this section.

Check For:

- ❑ Brief process description of the combustion unit
- ❑ Description of auxiliary equipment and unit operations associated with the system (see Component 1—How to Review a Trial Burn Plan, Section 3.0)
- ❑ Design information summary table
- ❑ Summary of process monitors and stack gas analyzers
- ❑ Process diagram showing monitoring points

Example Situation: In reviewing Appendix A (of the TBP), Lois noted that the TBP included the following information:

> "The combustion unit primary combustion chamber (PCC) is designed for an operating temperature of 800°F to 1,200°F, whereas the secondary combustion chamber (SCC) is designed for a temperature range of 1,000°F to 1,500°F. A residence time of 2 seconds in each chamber is provided. The SCC temperature will be measured upstream of any quench water injection."

However, the TBR shows a measured PCC temperature of 1,400°F and a SCC temperature of 900°F. The TBR does not indicate where the temperature in the SCC was measured or whether a 2-second residence time was achieved in each chamber.

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Example Action: The PCC operating temperature (1,400°F) is considerably higher than the design temperature (800°F to 1,200°F). The reason for this design inconsistency should be determined. The SCC temperature (900°F) during the trial burn is considerably below the design temperature of 1,000°F to 1,500°F. This major design inconsistency should be evaluated. Lois prepared a specific comment that reads: "Specify whether the SCC temperature was measured upstream of any quench water injection. If the temperature was measured upstream of quench water injection, the reason for such a low temperature should be determined."

To provide additional information for evaluation of this issue, Lois also requested that the residence time in each chamber be calculated on the basis of design information provided for each chamber. That is, volume, total air flow rate, and pressure.

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EXHIBIT 5.0-1

EXAMPLE TABLE OF PROCESS MONITORS

Parameter	Location of Monitor	Type of Monitor	Operating Range	Units Recorded in Process Log
High-Btu liquid waste feed rate	10A-Feed line to nozzle on SCC 10B-Feed line to nozzle on PCC	Mass flow meter	0 to 100	lb/min
Low-Btu liquid waste feed rate	11-Feed line to injector on SCC	Mass flow meter	0 to 100	lb/min
Auxiliary fuel flow	12A-Fuel oil line to SCC 12B-Fuel oil line to kiln	Mass flow meter	0 to 100	lb/min
Sludge waste feed rate	13-Feed line to injector on kiln	Mass flow meter	0 to 100	lb/min
Drummed solid waste charge weight	14-Automatic weigh scale at feed conveyor	Weigh scale	0 to 2,000	lb
Atomization steam pressure	15A-Waste burner in SCC 15B-Waste burner in kiln	Pressure transducer	0 to 100	pounds per square inch gauge
Rotary kiln temperature	16-Kiln outlet	Type R thermocouple	2,650	°F
SCC temperature	17-SCC	Type R thermocouple	2,650	°F
Quench inlet temperature	18-Quench inlet	Type J thermocouple	150 to 600	°F
Quench discharge temperature	19-Quench outlet duct	Type J thermocouple	150 to 600	°F
Adsorber temperature	20-Adsorber inlet	Type J thermocouple	150 to 600	°F
Ionizing wet scrubber (IWS) inlet temperature	21A-Inlet duct to IWS No. 1 21B-Inlet duct to IWS No. 2	Type J thermocouple	150 to 600	°F
Rotary kiln pressure (draft)	22-Rotary kiln chamber	Pressure transducer	-5 to 5	in water (H_2O)
SCC pressure (draft)	23-SCC	Pressure transducer	-5 to 5	in H_2O
Rotary kiln speed	24-Kiln rollers	Tachometer	0 to 1.0	rotations per minute
Quench water flow rate	25-Quench water line	Orifice meter	0 to 200	gallons per minute
Caustic water flow rate	26-Caustic water line to adsorber	Rotameter	0 to 50	gpm

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IWS water flow rate	27A-IWS water line to unit No. 1 27B-IWS water line to unit No. 2	Orifice meter	0 to 50	gpm

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EXHIBTI 5.0-1 (Continued)

EXAMPLE TABLE OF PROCESS MONITORS

Parameter	Location of Monitor	Type of Monitor	Operating Range	Units Recorded in Process Log
Oxygen	27B-IWS water line to unit No. 2	Zirconium oxide fuel	0 to 25	percent
Carbon monoxide	28-IWS outlet duct	Cell in situ nondestructive infrared	0 to 500	parts per million
Combustion gas flow rate	29-Stack	Resistance temperature flow detector	0 to 100,000	reference valve
Combustion air flow rate	30A-Air inlet duct to SCC 30B-Air inlet duct to kiln	Venturi meter		reference valve
IWS electrical readings	31A-Power lines to IWS electrodes for unit 1 31B-Power lines to IWS electrodesfor unit 2	Voltmeter,	0 to 20 0 to 200	kiloVolts milliAmps
Adsorber differential pressure	32-Adsorber inlet and outlet ducts	Pressure transducer	0 to 20	in H_2O
Scrubber water blowdown rate	33-Sewer line to National Pollutant Discharge Elimination System treatment system	Triangular weir	0 to 12	gpm

Notes:

Btu	British thermal unit
gpm	Gallons per minute
H_2O	Water
IWS	Clonizing wet scrubber
lb	Pound
lb/min	Pounds per minute
PCC	Primary combustion chamber
SCC	Secondary combustion chamber
ppm	Parts per million

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EXHIBIT 5.0-2

EXAMPLE PROCESS DIAGRAM INDICATING MONITORING POINTS

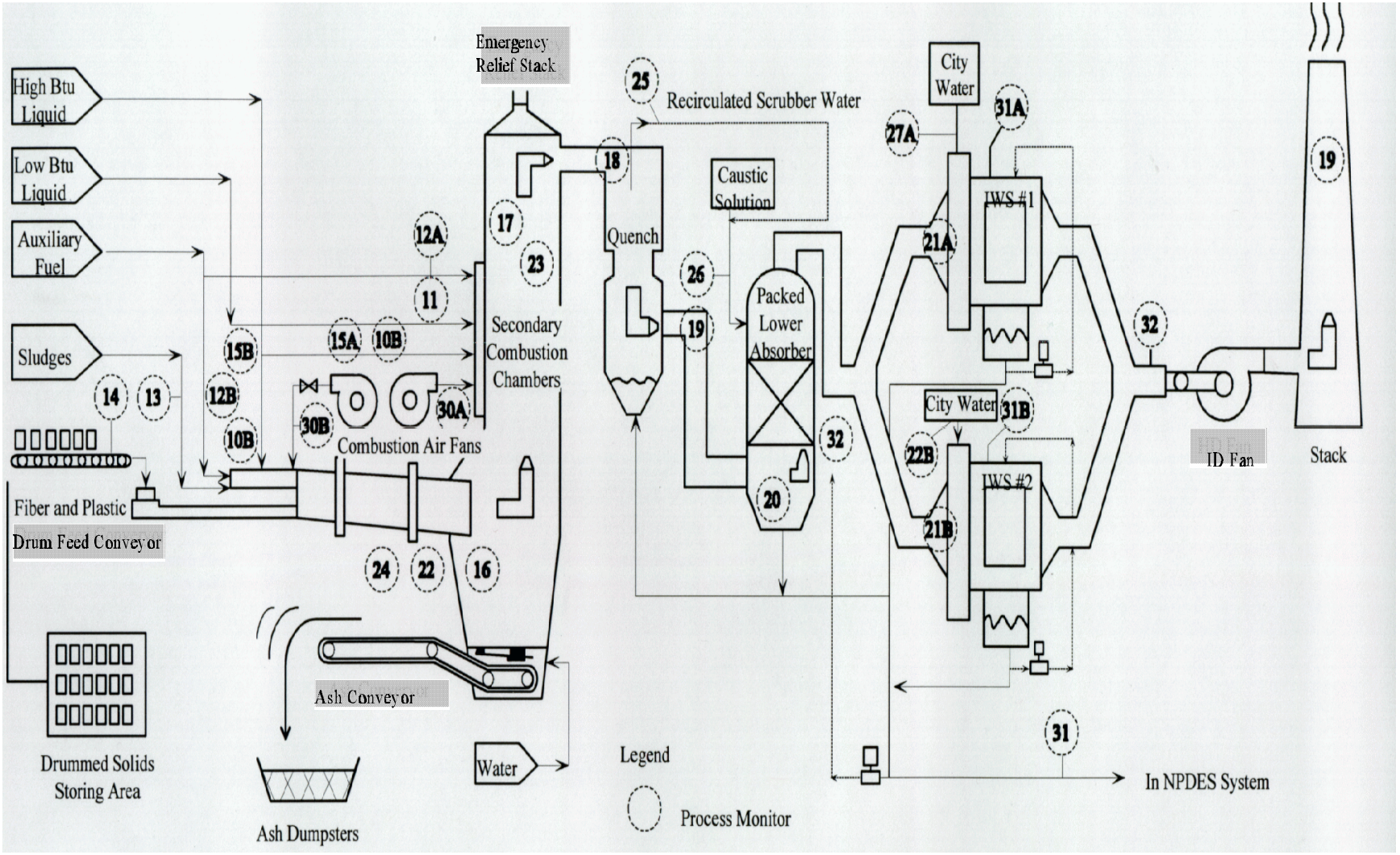

EXHIBIT 5.0-3

DESIGN INFORMATION SUMMARY

Parameter	Units
Incinerator Identification	
Installation date (year)	
Type of incinerator	

(diameter x length or height x width x length)		PCC	SCC	System
Inside dimensions				
Cross-sectional area				
Design heat release rate				
Design heat release rate				
Refractory thicknesss[a]				
Refractory conductivity[a]				
Refractory surface area[a]				
Cooled surface area				
Design pressure				
Identification fan capacity				
Stack diameter				
Stack height				

APCS design information (as applicable)	
Type(s) (such as quench, Venturi, and ESP)	
Maximum inlet temperature	
Minimum inlet temperature	
Maximum inlet pressure	
Minimum inlet pressure	
Design pressure drop (range)	
Design liquid flow (range)	
Design gas flow (range)	
Surface area (bags, plates)	
Voltage (specify AC/DC)	
Current	
HCl removal capacity	

Burner identification[b]	Type	Waste stream(s)	Atomizing fluid pressure[c]	Type atomizing fluid

Notes:

[a] Required for mass and energy balance
[b] Need only to identify burners used for waste
[c] Explain, if different from design specifications

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6.0 REVIEWING CHAPTER 3—TESTING PROGRAM OVERVIEW

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The *Overview of the Testing Program* section of the report should summarize trial burn objectives, the planned test program, actual testing conducted, and any deviations from the approved TBP.

Check For:

- ❑ Trial burn objectives
- ❑ Planned test program
- ❑ Summary of actual testing performed
- ❑ Deviations from the approved TBP

Example Situation: In reviewing the TBR, Clark checks the TBP to see whether all objectives (percent DRE of designated POHC greater than or equal to 99.99 percent); CO concentration less than 100 ppmv; and PM less than 0.08 gr/dscf) were met during the actual trial burn.

Clark also reviews the TBP to see whether the testing program was conducted (1) under specified test conditions; (2) at the documented mass feed rate; and (3) at the proposed heat input rate. The testing program also identifies testing methods used; Clark reviews the TBP to see whether specified methods were used, and in doing so discovers a deviation between the TBR and the TBP.

The TBR must identify and explain deviations from the approved TBP, if any. Examples of some deviations and their basis and impact are shown in Exhibit 6.0-1 (see page 6-30). Any deviations should be reviewed for their impact on the results.

Example Action: Clark notes the deficiency and his recommendation for corrective measures in his report, as follows:

"Deficiency: (see Exhibit 6.0-1, see page 6-30). This table states that specific polynuclear aromatic hydrocarbons (PAH) showed high background levels in samples from the MM5 train. However, the table does not identify the PAHs that showed high background levels or list specific sample numbers that indicated this anomaly.

"Recommendations: The table should list (1) all of the samples containing high background levels of PAHs, and (2) the PAHs identified."

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EXHIBIT 6.0-1
DEVIATIONS SUMMARY

Test Element	Deviation	Basis and Impact
STACK SAMPLING		
Trial Burn Stack Sampling Time	Addendum 1 of the TBP revised the testing program to allow up to 3 hours of stack gas testing. Initially, the Method 0050, hexavalent chromium, and formaldehyde trains were to be operated for 1 hour. This time was not changed. The Method 0050 trains were initially scheduled to operate for 2 hours. During the first run of the trial burn, these trains were operated for 2.6 hours. In subsequent runs, they were operated for 2.4 hours because of concerns regarding the amount of waste feed available. The volatile organic sampling train (VOST) sampling time was adjusted in the trial burn to 40 minutes per tube, set at a rate of 0.5 L/min, instead of 20 minutes per tube, set at a rate of 0.25 liters per minute (L/min). The methanol and Method 0040 trains were initially scheduled to be operated for 2 hours each. In the trial burn, the methanol train was operated for 3 hours, and the Method 0040 train was operated for 2.5 hours.	The additional sampling time was proposed to allow an additional sample to be collected. The impact was to further improve sampling train detection limits. The facility evaluated the analytical results from the last tube in the VOST train to ensure that breakthrough did not occur.
Trial Burn Stack Sampling Sequence	The planned trial burn sequence specified that particulate sampling be conducted separately from aldehyde and hexavalent chromium sampling. Instead, the particulate and formaldehyde and hexavalent chromium trains were operated concurrently at the start of each run, in addition to the VOST, Method 0040, and Method 18 trains. The MM5 trains were not started until the second half of the particulate train operation.	Because stack traverse points overlap, the particulate, and formaldehyde and hexavalent chromium trains could not be operated concurrently with the MM5 trains. This restriction extended the total length of each test run but did not otherwise affect the trial burn program. This deviation should not change stack sampling results.
Chromium Sampling Train Preparation	The TBP specified the use of a 0.1N potassium hydroxide (KOH) charging solution in the sampling train. A 1 N solution was used instead.	The change was based on previous experience. The stronger solution had no impact on the analytical program, as shown in the QC data presented in Appendix E.
Chromium Sampling Train Operations	In Run 5, at the last traverse point of the first port (traverse point 12), the probe KOH recirculation line detached. The sample was collected for a short period without KOH being recirculated.	An additional 2 minutes were added to the total sampling time as a conservative means of accounting for the short period during which KOH was not being recirculated. Adding the additional 2 minutes could bias the chromium emissions in Run 5, resulting in slightly higher results.
	During Run 5, at the last traverse point (point 24), the probe tip fell off but did not break. This occurred because it was necessary to tilt the sampling train up to remove it from the stack. During this tilting, the probe snagged on the port, pulling the tip out. The preleak check had been good, and the leak check that was conducted after the probe was put back on was good.	The probe incident was unanticipated. Considering that the leak checks before and after the probe fell off were good and the probe was in the stack, the impact of this event is insignificant.

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EXHIBIT 6.0-1 (Continued)
DEVIATIONS SUMMARY

Test Element	Deviation	Basis and Impact
STACK SAMPLING (continued)		
Method 0040 Train Operation	The Tedlar sample bag that was to be analyzed for Run 7 (Bag 1) was broken during the sampling train operation. The second bag was collected successfully. The Tedlar bag sample that was analyzed for methanol in the stack gas was also analyzed for volatile unspeciated mass, and the data point was salvaged.	Because the two samples are similar, there should be no significant impact on data quality. Appendix E contains information regarding the analysis.
Method 18 Train Operation	During the trial burn, two bags, instead of three, were used to collect the sample.	The purpose was to reduce the efforts of the on-site QC operator. Analytical results were consistent from bag to bag, so this deviation did not affect the trial burn results.
PROCESS SAMPLING		
Samples of Ash Collection and Analysis	The TBP specified that 50 milliliters of feed sample be collected at 15-minute intervals to build a 1-liter sample and that 250 milliliters be used for ash analysis. About 150 milliliters were collected at 15-minute intervals to build a 1-gallon composite sample, and 40 milliliters were used for ash analysis. After considerable ash variability was visually observed in duplicate 40-milliliter vials, the 40-milliliter vial samples were determined to be nonrepresentative. The 500-milliliter samples were analyzed. Results of both were reported.	Transferring a part of the total sample to 40-milliliter sample vials did not provide a representative sample. After this was discovered, the 500-milliliter sample was analyzed instead to provide a more representative sample, consistent with the TBP minimum sample size of 250 milliliters. The increase in aliquot size and total sample volume provided a more representative sample.
Spark Arrestor Ash	The TBP specified that spark arrestor ash samples be collected for various analyses. Only one sample of spark arrestor ash was obtained from the low-temperature test condition. There was insufficient ash to collect a sample from the second test condition.	This deviation has no impact on the trial burn program, because no spark arrestor ash—other than the one sample—was generated.
MISCELLANEOUS		
Determining Correlation Between Baghouse Differential Pressure and Ash Loadings	Addendum 1 of the TBP specified that a test would be conducted to demonstrate the correlation between baghouse differential pressure and stack flow at different baghouse ash loadings. This test was not conducted because it was not possible to build up the required ash loading in the baghouse.	The test was designed so that the facility could take credit for the variance of the baghouse differential pressure with stack gas flow rate. The alternative was to accept the differential pressure from the test, with no allowance for flow rate adjustment. Because the correlation between baghouse differential and ash loading could not be determined, the permit limit will be based on the baghouse differential pressure demonstrated during the trial burn.
Soot Blowing	Soot blowing was planned for the third run in each test. Soot blowing was conducted throughout the second run of the high-temperature test.	Additional soot blowing was factored into the soot-blowing equation used to correct metals and particulate concentrations and emission rates.

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EXHIBIT 6.0-1 (Continued)
DEVIATIONS SUMMARY

Test Element	Deviation	Basis and Impact
MISCELLANEOUS (continued)		
Trial Burn AWFCO Setpoint	The TBP specified AWFCO limits that would be in effect during the trial burn. During the trial burn, the stack gas flow rate, steam production, and baghouse differential pressure were revised.	An annuber stack gas flow meter was used to determine the stack gas flow during the trial burn. This unit was installed immediately before the trial burn. Based on the characteristics of the annuber, the flow limit was revised to 20,890 actual cubic feet per minute (acfm). The TBP did not specify a minimum baghouse differential pressure. Before the trial burn, EPA determined that a limit should be set. The limit was set at 0.2 inch water column (w.c.). The steam production limit was adjusted higher because it was found that the unit could produce more steam under trial burn conditions. The maximum steam production limit was revised to 40,000 lb/hr.
ANALYTICAL		
VOST Audit	A VOST audit was planned as part of the trial burn. Because of government contracting issues, a VOST audit was not available.	The absence of a VOST audit does not have a significant impact on the evaluation of the results. The TBP includes matrix spike/matrix spike duplicates and resin spikes for evaluating accuracy and precision.
Methanol Train Calibration Gas	The TBP proposed the use of Protocol 1 calibration gases for methanol analysis. Protocol 1 calibration gases could not be obtained commercially. Instead, commercially obtained calibration gases used in the pretest were analyzed in triplicate by the laboratory, and the average values used as the calibration rate.	Method 18 specifies that prepared standards be used for calibration. Trial burn calibration standards were commercially prepared and were analyzed (1) by a standard method to provide accuracy, and (2) in triplicate to allow precision to be evaluated. Therefore, the accuracy of the standards was adequately demonstrated. This deviation had no impact on trial burn results.

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EXHIBIT 6.0-1 (Continued)
DEVIATIONS SUMMARY

Holding Time—Volatile Total Organic Condensate	The shipment of the Method 0040 condensate samples from Run 8 were misrouted by the overnight carrier and arrived at the laboratory 1 day late. When logged in, the temperature in the ice chest was found to be greater than the 4 °C shipping temperature.	Sampling results for this train are reported as a bag sample portion and a condensate portion. Condensate results from Run 8 are 4.4 percent of the total volatile organics loading on the train. For Runs 7 and 9, condensate results are 4.5, 4.5 percent of the train totals. Because Run 8 sample results are consistent with the other samples from the same test condition, there is no discernable impact on the results.
Test Element	**Deviation**	**Basis and Impact**
ANALYTICAL (continued)		
High Background PAH Concentrations on XAD Resin	The samples from MM5 Train A showed high background levels of some PAHs. These levels presented some difficulties in the evaluation of some data quality objectives associated with the constituents.	The constituents with high background problems were not the constituents that will be evaluated as benzo(a)pyrene toxicity equivalent in the human health risk assessment. Therefore, high background levels do not affect the risk assessment evaluation.
Use of Alternative Sample	In the PAH analysis of the Run 7 sample from MM5 Train A (Sample B-1313), the sample was lost during the extraction process. The Train B archive sample portion from Run 1 (B-1320) was used instead.	The trial burn was specifically designed so that a portion of Train B could be used in the event of problems with Train A. Therefore, this substitution does not affect the test results.
Low Matrix Spike Recoveries for Aldehydes	Laboratory matrix spike recoveries were outside the QC tolerances specified in data quality objectives. Matrix spikes were performed on the first impinger of Runs 7 and 8. Recoveries for formaldehyde were 72 and 0 percent, respectively. Recoveries for acataldehyde were 45 and 37 percent, respectively. Appendix E contains additional discussion. The dinitrophenylhydrazine (DNPH) solution might have become deactivated when matrix spikes were added.	These relatively poor matrix spike recoveries are at sufficient levels for these data to be regarded as representative of stack gas emissions of these aldehydes. The acetaldehyde data will be used in the human health risk assessment. Because concentrations found in the samples were low, the impact on the human health risk assessment will probably be minor. However, the uncertainty associated with low recoveries should be evaluated in the risk assessment.

7.0 REVIEWING CHAPTER 4—TEST OPERATING CONDITIONS

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: During preparation of the TBP, the facility establishes the limits for the test and process operating parameters, including specific operating parameters for the APCS, to ensure that emissions of metals, HCl, chlorine gas (Cl_2), PM, and others are not likely to exceed allowable limits.

Check For: Review the TBR to see whether all operating parameters listed in the TBP are recorded and are within established limits. Check for average, minimum, maximum, and standard deviation of the values collected.

- ❑ Waste and fuel feed rate information (see Section 7.1)
- ❑ Process residuals generation rate and characterization information (see Section 7.2)
- ❑ Stack gas parameter information (see Section 7.3)
- ❑ Fugitive emissions sources and means of control (see Section 7.4)

Example Situation: In comparing the TBP to the TBR, Lois and Clark ask that the facility explain why parameters are not within established limits. Lois and Clark will then review the explanation to ensure its validity. Sections 7.1 through 7.4 of this component provide explanation for some operating conditions listed above.

Example Comments: Example comments for each listed operating condition are included separately in Sections 7.1 through 7.4 of this component.

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7.1 REVIEWING WASTE AND FUEL FEED RATE INFORMATION

Regulations: 40 CFR Part 264.345(b)

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section III.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2 and Appendix F, Forms 3 and 4.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapters 3 and 5.

Explanation: A hazardous waste feed rate limitation is required under 40 CFR Part 264.345(b), mainly to minimize a potential loss of efficiency or unsafe situation caused by overloading the combustion chamber. For maximum operating flexibility, two levels of hazardous waste feed rate parameters should be maximized: (1) combined feed rate of all hazardous waste feed streams, and (2) combined feed rate of all pumpable hazardous waste feed streams. Also, the data logsheet should be reviewed to see whether more than one type of auxiliary fuel, such as natural gas, process gas, coal, or fuel oil, is fired.

Check For: The instantaneous and hourly rolling averages (HRAs) values for each of the following parameters should be presented for each run of the trial burn test.

- ❑ Maximum organic (high heating value [HHV]) liquid waste feed rate
- ❑ Maximum aqueous (low heating value [LHV]) liquid waste feed rate
- ❑ Maximum containerized waste (that is, container size and type) feed rate
- ❑ Maximum sizes of containerized waste batches
- ❑ Maximum feed rate of each waste type to each combustion chamber
- ❑ Hazardous waste blending procedure, analysis of each waste before blending, and blending ratio (only if more than one hazardous waste stream is blended)
- ❑ Review the data logsheets (units, rate) to assure that the results presented are accurate and consistent
- ❑ Solid waste feed rate
- ❑ Auxiliary fuel feed rate

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If the facility is reporting the results of a risk burn, additional data should be provided. These data may include the following:

- ❑ Average hazardous waste feed rate (each stream) for each risk burn run
- ❑ Minimum and maximum hazardous waste feed rate (each stream) for each risk burn run
- ❑ Supporting data regarding normal operating conditions (may also be submitted as part of the RBP)

Example Situation: Because hazardous waste feed parameters are set when the TBP is prepared, Lois compares the TBR to the TBP to determine whether the feed rate during the actual burn was consistent with proposed feed rates.

Lois notes that she needs the following information if hazardous waste is blended: (1) hazardous waste feed rate information, including blending procedure; (2) a detailed analysis of the hazardous waste before blending; (3) an analysis of the material blended with the hazardous waste; and (4) the blending ratios.

Appendix D—Process Sampling Report should contain the process operating data logsheet completed during the trial burn test. This logsheet should contain the liquid waste feed rate measured at regular intervals during the trial burn test. For consistency, the reviewer should compare liquid feed rate units (such as pounds per minute [lb/min], lb/hr, and kilograms per hour [kg/hr]) reported with those on the logsheet. Also, the data logsheet should be reviewed to see whether more than one type of liquid waste is being fed to the combustion chamber.

If liquid waste feed is reported as a volumetric rate (gallons per hour [gph], cubic meters per hour [m^3/hr], or cubic feet per hour [ft^3/hr]) on the data logsheet, sample calculations should be included in the report, showing conversion from volumetric feed rate to mass rate.

Example Action: During her review of a TBR, Lois notes that the data logsheet contained in Appendix D reports a value for the liquid waste feed rate in kg/hr, whereas the TBR shows the same feed rate in lb/hr. Lois asks that the facility verify the feed rate units and present the waste feed rate value with the correct units.

She also notes that the TBP states that the maximum solid waste feed rate would be set at 1,800 lb/hr, whereas during the actual trial burn test, the solid waste feed rate was 1,500 lb/hr. She asks the facility to explain the lower feed rate.

Finally, Lois notes that the data logsheet (Appendix D) reported the auxiliary fuel rate of natural gas in standard cubic feet per minute (scfm), whereas the TBR shows the auxiliary feed rate in lb/hr. Lois makes a note to verify the auxiliary fuel firing rate, and to request that the facility revise the TBR to reflect the correct units if a problem is found.

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7.2 REVIEWING RESIDUALS GENERATION RATE AND CHARACTERIZATION INFORMATION

Regulations: No regulations are applicable to this section of the manual.

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section IV.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5.

Explanation: Samples of ash, process effluents (such as scrubber water), and solid residuals (such as baghouse, spark arrestor, and residual ash) should be collected and analyzed for the compounds of concern identified by the TBP or RBP (for example, PICs, POHCs, metals, or chlorine). The ash, process effluents, and solid residual generation rate should also be calculated.

Check For:

- ❑ Ash, process effluents, and solids residuals identification
- ❑ Sampling method
- ❑ Sampling frequency (every 15 minutes and 1 hour composite)
- ❑ Sampling duration (minimum 1 hour sampling time per run)
- ❑ Sampling location
- ❑ Ash, process effluents, and residual generation rate
- ❑ Ash, process effluents, and residual analytical data

Example Situation: In reviewing the TBR, Clark read that an ash sample from the kiln was collected, but analytical results did not show the presence of any compounds of concern.

Example Action: Clark asks that the facility revise the TBR to describe how the ash sample was collected (one grab sample per run is recommended). It should also present (1) analytical results that identify the parameters analyzed, and (2) detection limits.

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7.3 REVIEWING STACK GAS PARAMETER INFORMATION

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section III.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2 and Appendix F, Forms 3 and 4.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapters 3 and 5.

Explanation: During the trial burn test, monitoring of several specific parameters is required. Permit limits are set for these monitored parameters. These parameters—such as CO concentration, stack gas flow rate, combustion temperature, APCS inlet gas temperature, and pressure drop—are monitored because it is important to ensure good combustion and APCS operating practices, and compliance with the regulations.

Check For:

- ❑ CO emission levels, in ppmv, corrected to 7 percent O_2 (see Section 7.3.1)
- ❑ Stack gas flow rate and velocity at actual, dry standard, and 7 percent O_2 conditions (see Section 7.3.2)
- ❑ O_2 levels in volume percent (see Section 7.3.3)
- ❑ Inlet gas temperature to the dry APCS (see Section 7.3.4)
- ❑ Combustion unit temperature (see Section 7.3.5)
- ❑ APCS control parameters (see Section 7.3.6)

Example Situation: In reviewing the TBR, Clark verifies that it presents all stack parameters. Sections 7.3.1 through 7.3.6 of this component include example sections for each parameter.

Example Comments: Sections 7.3.1 through 7.3.6 of this component include example sections for each parameter.

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7.3.1 Verifying Stack Gas Carbon Monoxide

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F and Form 6.

Explanation: CO concentration in the flue gas is an indicator of combustion efficiency. High CO emissions can result from insufficient combustion air, poor mixing, improper atomization, or excessive organic compound volatilization.

Check For:

- ❑ CEMS CO concentration during the trial burn in ppmv (minimum of three runs per test condition) corrected to 7 percent O_2.

  The following values should be provided for each run of the trial burn test:

  - ❑ Minimum and maximum instantaneous concentrations
  - ❑ Minimum and maximum HRA concentrations
  - ❑ Standard deviation of instantaneous and HRA values
  - ❑ Average instantaneous and HRA values for all runs at each test condition

- ❑ CEMS CO strip chart and original log recorded during testing
- ❑ If dual CO CEMS are installed, confirm which monitor corresponds with which strip chart or data set.

Generally, the permit target value for CO emissions is 100 ppmv, corrected to 7 percent O_2.

Example Situation: In reviewing the TBR, Lois uses the following formula to check the CO conversion at 7 percent O_2:

$$CO_c = CO_m \left(\frac{14}{21 - Y}\right)$$

where

CO_c	=	Corrected CO level at 7 percent O_2
CO_m	=	Measured CO level
Y	=	Measured O_2 concentration in the stack gas on a dry-gas basis

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(14 and 21 are values used for conversion purposes)

Example Action: Lois uses the formula to review calculations for each run and to verify the measured CO level by reviewing the strip chart and CO field log data sheet. Also, she verifies that the measured O_2 concentration is on a dry-gas basis.

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7.3.2 Verifying Stack Gas Flow Rate

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F and Form 6.

Explanation: Title 40 CFR Part 264.345(b)(4) requires that the permit specify an acceptable operating limit using "an appropriate indicator of combustion gas velocity." Combustion gas flow rate is a direct measurement of combustion gas velocity. Combustion gas velocity is directly related to the gas residence time in the combustion unit. Residence time is an important indicator of combustion unit destruction efficiency and PIC formation. Stack gas flow rate is a common indicator of combustion gas velocity. The stack gas flow rate is not always linear in comparison to the actual combustion gas flow rate within the combustion chambers. However, the stack gas flow rate is an easily monitored and reliable measurement and is proportional to the actual combustion gas flow rate.

Check For:

- ❑ Stack gas flow rate and velocity (minimum of three runs per test condition)

  The following values should be provided for each run of the trial burn test:

  - ❑ Minimum and maximum instantaneous concentrations
  - ❑ Minimum and maximum HRA concentrations
  - ❑ Standard deviation of instantaneous and HRA values
  - ❑ Average instantaneous and HRA values for all runs at each test condition
- ❑ Location of stack gas flow rate measurement
- ❑ Whether stack gas flow rate is within limits of the TBP target and, if not, an explanation for being outside the limits
- ❑ Stack gas flow rate and velocity calculations, including water (H_2O), O_2, nitrogen (N_2), carbon dioxide (CO_2), and CO levels in the flue gas
- ❑ Stack gas flow rate values for actual, dry standard, and 7 percent O_2 conditions.
- ❑ Whether reported values are consistent with test operating data

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Example Situation: In reviewing the TBR, Clark notes that stack gas flow rate for three runs under the same operating conditions were reported as 1,200, 1,300, and 1,800 (actual cubic feet per minute (acfm) with an average of 1,433 acfm.

Example Action: Stack gas flow rates for all three runs should be close, because the runs are theoretically conducted under the same operating conditions. Clark checked the calculations and data logsheets to verify the reported value. He reviewed the waste feed rate and auxiliary fuel rate O_2 levels during these runs to determine why the measured flow rates varied among runs.

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7.3.3 Verifying Stack Gas Oxygen Concentration

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F, Form 6.

Explanation: Complete combustion of POHCs and PICs requires the presence of sufficient O_2. The O_2 level is measured in the flue gas as an indirect indicator of combustion efficiency.

Measurement of O_2 levels is also necessary to convert the CO concentration, stack gas velocity and flow rate (and therefore the emission rate of COPCs) to 7 percent O_2 levels based on actual O_2 monitoring data.

Check For:

- ❑ O_2 concentration in the flue gas during the trial burn (minimum of three runs per test condition, on a dry-gas basis

  The following values should be provided for each run of the trial burn test:

  - ❑ Minimum and maximum instantaneous concentrations
  - ❑ Minimum and maximum HRA concentrations
  - ❑ Standard deviation of instantaneous and HRA values
  - ❑ Average instantaneous and HRA values for all runs at each test condition

- ❑ CEM O_2 strip chart and original log recorded during the testing
- ❑ Whether O_2 levels during testing are within the limits of the trial burn target and, if not, whether excursions beyond the limits are explained

Example Situation: In reviewing the TBR, Lois read that O_2 levels for test Condition 1 for all three runs averaged 7.7 percent, with a range of 7 to 8 percent; and that an operating envelope of 7 to 8 percent will be used for actual operations. However, while reviewing the continuous monitoring O_2 strip chart scale, Lois could only find data that indicated the O_2 concentration ranged from 8 to 9 percent, with an average of 8.8 percent.

Example Comments: Lois was confused because she could not determine what data the facility had used to determine the proposed operating envelope. She developed a comment requesting that the facility review actual O_2 values and calculations and revise the proposed operating envelope, as appropriate.

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7.3.4 Verifying Air Pollution Control Equipment Inlet Gas Temperature

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: APCS inlet temperature is a regulated BIF parameter for which a limit must be determined. Guidance recommends limiting APCS inlet gas temperature for all combustion units because of its effect on (1) the formation of dioxin-like compounds in dry APCS, (2) APCS performance, and (3) equipment deterioration. Higher APCS temperatures would minimize condensation so that less of the particulate-forming material could be collected. Temperatures measured during the dioxin test runs should be closely evaluated during development of permit limits to ensure that formation of these compounds will be minimized. The reviewer should closely evaluate any APCS inlet temperature greater than 400°F. The maximum temperature should not be higher than specified by the manufacturer to ensure effective operation and to prevent malfunction. Limiting inlet gas temperature applies to a variety of APCS, including adsorbers, venturi scrubbers, baghouses, electrostatic precipitators, and ionizing wet scrubbers.

Check For:

- ❑ Inlet gas temperature to the APCE during the trial burn test (minimum of three runs per test condition)

  The following values should be provided for each run of the trial burn test:

  - ❑ Minimum and maximum instantaneous concentrations
  - ❑ Minimum and maximum HRA concentrations
  - ❑ Standard deviation of instantaneous and HRA values
  - ❑ Average instantaneous and HRA values for all runs at each test condition

- ❑ Continuous temperature strip chart or digital data recorded during the testing

Example Situation: During review of the continuous temperature data, Clark noted that the average inlet temperature to the APCS was 1,000°F, whereas design information contained in the TBP indicated that the maximum design temperature of the APCS is 950°F.

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Example Action: The actual temperature is higher than the design maximum temperature for the APCS. Clark asks that the facility provide the manufacturer's actual APCS design data and explain the higher temperature.

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7.3.5 Verifying Combustion Unit Temperature

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section III.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F, Form 6.

Explanation: Combustion chamber temperature must be limited by both a minimum and maximum value. A high combustion zone temperature can lead to increased metals vaporization which may, in turn, increase emissions of hazardous metals. Conversely, a low combustion zone temperature can lead to decreased destruction efficiency for organic compounds, which may result in increased emissions of hazardous organics constituents. During a trial burn test, the facility should continuously measure combustion zone temperature; these continuous values are used to calculate and record average 1-minute values. The 1-minute values are used to calculate the following values for each run:

- Average
- Maximum
- Minimum
- Average HRAs
- Maximum HRAs
- Minimum HRAs

Standard deviations for each of these calculated values should also be presented.

Permit limits on minimum and maximum combustion zone temperatures for conventional trial burn tests are typically calculated using the average HRAs value from the three low-or high-temperature test runs. Permit limits based on risk burn data will be based on the arithmetic mean of the lowest and highest average HRAs values recorded during each of the three risk burn runs. Development of permit limits for combustion zone temperature is discussed in detail in Component 7—How to Prepare Permit Conditions.

If the combustion device contains both a PCC and an SCC, temperature should be measured inside each chamber. Alternative temperature locations should be as close to the combustion zone as is practical and must be upstream of any quench water injection.

Check For:

- ❑ Combustion unit temperature during the trial burn (minimum of three runs per test condition)

  The following values should be provided for each run of the trial burn test:

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- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ Continuous temperature strip chart recorded during testing

❑ If dual thermocouples are installed, confirm which instrument corresponds to which strip chart or data set

❑ Whether trial burn temperatures are near target values established in the TBP

❑ Verify all calculated values presented in the TBR

Example Situation: Lois reviews two average PCC temperatures 1,225°F and 1,281°F measured by two probes located on opposite sides of the combustion chamber. She becomes suspicious because of the large temperature difference, but based on the instantaneous data the averages appear to be correct. A further detailed review of the calibration data for the thermocouples indicates that, given the ±50°F accuracy of the thermocouples used, the 56°F difference between the two values is acceptable.

Example Action: Although Lois determines that the data is acceptable, so that future readers will understand the reason for the temperature difference, she requests that the facility add a detailed discussion to the TBR explaining (1) why the two average values are so different, (2) how the calibration data support the difference, and (3) why the data are acceptable.

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7.3.6 Verifying Air Pollution Control System Control Parameters

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section III.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F, Form 6.

Explanation: APCS control parameters must be recorded in order to set permit limits that will maintain the particulate and acid gas removal efficiency demonstrated during the trial burn. The TBR should include a continuous record of each control parameter monitored (see below), as well as the following calculated values as appropriate:

- Average
- Maximum
- Minimum
- Average HRAs
- Maximum HRAs
- Minimum HRAs

The standard deviation of each of these calculated values should also be presented. The use of these values to establish permit limits is described in detail in Component 7—How to Prepare Permit Conditions.

Check For: Based on the type of APCS used, various control parameters must be recorded during the trial burn test and reported in the TBR. Important control parameters may include:

- ❑ Baghouse and fabric filter
  - ❑ Inlet gas temperature
  - ❑ Pressure drop
  - ❑ Flue gas flow rate
  - ❑ Air-to-cloth ratio
- ❑ Electrostatic precipitator
  - ❑ Inlet gas temperature
  - ❑ Direct current voltage
  - ❑ Flue gas flow rate
- ❑ Venturi Scrubber
  - ❑ Inlet gas temperature

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- ❑ Pressure drop
- ❑ Liquid flow rate
- ❑ Liquid to flue gas ratio
- ❑ Maximum suspended solids
- ❑ pH (if used for acid gas removal)

The reviewer should check to ensure that continuous data for each applicable control parameter are included in the TBR. The reviewer should also verify all calculated values.

Example Situation: In reviewing the TBR, Clark notes that the facility (1) uses a venturi scrubber as an APCS, and (2) records inlet gas temperature and liquid flow rate as control parameters.

Example Action: Clark notes that venturi scrubber pressure drop is a key control parameter, indicating the performance of the system. Clark asks that the facility explain why it does not measure this key parameter.

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7.4 REVIEWING FUGITIVE EMISSIONS SOURCES AND MEANS OF CONTROL

Regulations: 40 CFR Part 270.62(b)(6)
40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 6.

Explanation: Regulations require that fugitive emissions be controlled by (1) sealing the combustion zone against fugitive emissions, (2) maintaining the combustion zone pressure lower than atmospheric pressure, or (3) using an alternative means.

The objective of these requirements is to ensure that potentially toxic gases are not emitted through leaking seals, access doors, expansion joints, or openings in combustion devices.

Additional requirements for monitoring and controlling fugitive emissions are highlighted in Component 3, Section 2.10, of this manual.

Check For:

- ❑ The existence of a fugitive emissions control system
- ❑ Whether fugitive emission controls include the following:
  - ❑ Sealed combustion zone
  - ❑ Combustion zone pressure lower than atmospheric
  - ❑ Alternative fugitive emissions control scheme of periodic monitoring used for systems operating at pressures higher than atmospheric

Example Situation: Lois noted that the TBR did not contain any information on the fugitive emissions control system for the combustion zone.

Example Action: Lois reviews the design information contained in the TBP, as well as the process monitoring and process description (see Section 5.0 of this component) portion of the TBR for the combustion zone design and actual pressure. This pressure should be lower than atmospheric pressure. If it is not, Lois will ask the facility to identify the fugitive emission control system that was used.

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8.0 REVIEWING CHAPTER 5—PROCESS AND STACK GAS SAMPLING

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 5.

Explanation: Process and stack gas sampling results are used to develop permit limits. This section of the TBR describes process and stack gas sample types, sampling points, sampling methods, sampling frequency, and sample preparation methods. It also contains APCS parameter sampling procedures.

Check For:

- ❑ Sampling locations and methods (see Section 8.1)
- ❑ Waste and fuel feed sampling (see Section 8.2)
- ❑ Process residuals sampling (see Section 8.3)
- ❑ Stack gas sampling procedures (see Section 8.4)

Example Situation: Clark reviewed the TBP to ensure that all types of process and stack gas sampling listed were conducted during the actual trial burn test. He also reviewed various hourly analytical data to assure that waste feed stream characteristics were consistent. Clark referenced Section IV of the Checklist for Reviewing RCRA Trial Burn Reports to aid in the review of procedures for process and stack gas sampling.

Based on his review of the TBP included as Appendix A to the TBR, Clark learned that the sample from the gaseous waste feed stream was to have been sampled once every 15 minutes and analyzed for the potential POHC of concern. The TBR, including the analytical data, indicated that the gaseous waste stream was sampled only once every hour.

Example Action: Clark develops a comment asking that the facility explain why it did not sample the gaseous stream once every 15 minutes. Clark states that if the composition of the gas stream does not change and is regularly generated from the same equipment, an hourly sample may be adequate. Therefore, Clark requests that detailed statistical data be provided by the facility supporting the consistency of the gaseous waste steam composition and the deviation from the TBP before he can complete his assessment.

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8.1 REVIEWING SUMMARY OF SAMPLING LOCATIONS AND METHODS

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section IV.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92011. Chapter 5.

Explanation: This section of the manual summarizes locations and methods used for each process sampling parameter.

Check For:

- ❑ Liquid waste feed sampling location and method
- ❑ Solid waste feed sampling location and method
- ❑ Auxiliary fuel feed sampling location and method
- ❑ Gaseous waste feed sampling location and method

Example Situation: Lois reads in the TBR that "Liquid waste feed samples were collected at 15-minute intervals and composited over each run. Liquid waste feed samples were collected from the incoming line to the feed tank." Is this procedure acceptable?

Example Action: No. More desirable locations for collecting the liquid waste feed include (1) from a sampling port in the waste feed line just upstream of the burner, (2) from a sampling port in the waste feed tank recirculation line, or (3) from the feed tank itself (in that order). This method would provide a uniform, consistent sample to compare to the sample collected from the incoming line to the tank. Lois needs to review the oversight report and the TBP to (1) determine if the alternative sampling location was approved, and (2) ensure that waste feed samples collected at this location are representative of waste fed to the combustion unit.

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8.2 REVIEWING SUMMARY OF WASTE AND FUEL FEED SAMPLING

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Checklist for Reviewing RCRA TBRs." Revision 3. February 10. Section IV.

U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5, Table 5-1, Table 5-4, and Appendix F.

Explanation: Waste feed and fuel feed must be analyzed for all parameters, as outlined in the approved TBP. Analysis for ash, heating value, metals, viscosity, chlorine, and POHCs is required, whereas analysis for other parameters may not be required.

Check For:

- ❑ Whether all hazardous waste feed streams are sampled
- ❑ Whether all auxiliary waste feed streams are sampled
- ❑ Whether all solid waste feed streams are sampled
- ❑ Parameters analyzed (such as moisture, density, ash, viscosity, heating value, and halides)
- ❑ Sampling method
- ❑ Sampling frequency (liquid waste: one every 15 minutes; solid waste: one every 15 minutes for bulk solid waste, one representative grab sample for containerized solid waste; auxiliary fuel feed: one per run)
- ❑ Composite sampling method used if different waste streams are involved
- ❑ Sampling location
- ❑ Sampling duration (minimum 1 hour per run)

The following subsections further describe how to review the following information:

- ❑ POHC feed rate (see Section 8.3.1)
- ❑ Ash feed rate (see Section 8.3.2)
- ❑ Cl_2 feed rate (see Section 8.3.3)
- ❑ Hazardous metal feed rate (see Section 8.3.4)

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- ❑ Combustion unit heat input rate (see Section 8.3.5)

Example Situation: Lois and Clark reviewed the waste and fuel feed sampling in the TBR and TBP. The following are their observations:

- In reviewing the TBR, Lois and Clark note that one grab sample of liquid waste was collected every 15 minutes and composited into one sample for each run; however, the TBR does not specify the sample volume, sampling location, or sampling method.

- The TBR stated that representative samples from two different solid waste streams were collected and analyzed for the parameters of concern.

Lois and Clark review the TBR further to see whether auxiliary fuel feed parameter sampling was conducted as outlined in the approved TBP. An auxiliary fuel stream such as supplemental natural gas will not require extensive parameter sampling, whereas a fuel oil-type auxiliary fuel stream (which may contain a variety of volatile and semivolatile PICs or PIC-precursors) will require more detailed parameter sampling. The TBR indicated that the facility uses fuel oil number 2, supplied by XYZ Pipeline Company, as the auxiliary fuel. The TBR also indicated that only one sample was analyzed during the entire stack test.

Example Action: Lois and Clark take the following actions:

- Lois and Clark ask that the facility specify the sample volume (100 milliliters per grab sample every 15 minutes is recommended), sampling location, and sampling method. If the waste is fed to the BIF unit from a storage tank, the preferred sampling location would be the recirculation line or the storage tank.

- Clark reviews the TBR (Appendix D) to see whether the frequency of sampling for these two solid waste streams is identified and carried out in accordance with the approved TBR. For containerized solid waste, grab representative samples from each drum, composited into one sample for each run, are recommended; for bulk solid waste, one grab sample collected every 15 minutes, and composited into one sample for each run, is recommended. Clark asks the facility to summarize this information in the text.

- The preferred frequency of sampling for auxiliary fuel feed is one per run. The analytical results for a single sample collected during the trial burn test should be acceptable, provided that the facility submits supporting information demonstrating that the

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characteristics of the fuel oil used at the facility are consistent over time.

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8.2.1 Verifying Principal Organic Hazardous Constituent Feed Rate

Regulations: 40 CFR Part 266.103
40 CFR Part 266.104

Guidance: No specific references are applicable to this section of the manual.

Explanation: For all runs of the test condition designed to demonstrate DRE, 40 CFR Part 266.104 requires that the facility's permit specify POHCs among those constituents listed in Part 261, Appendix VIII for each waste to be burned.

The TBR reviewer should check that all POHCs have been identified and verify all POHC feed rate calculations.

Check For:

- ❑ Type of POHC measured in each waste during the trial burn
- ❑ POHC feed rate of each waste during the trial burn
- ❑ POHC mass rate calculations in the appendix of the report

Example Situation: The types and amount of POHCs in the waste are important to overall combustion unit performance. The facility will evaluate the overall ability of the combustion unit to destroy POHCs during the trial burn. Generally, organic constituents that are the most difficult to combust are designated as POHCs during preparation of the TBP.

Example Comments: Lois checked the TBP (typically included as Appendix A to the TBR) to see if the POHCs identified in the waste feed were analyzed and feed rates calculated during the trial burn. She found both factors consistent with the TBP.

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8.2.2 Verifying Ash Feed Rate

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Typically, the PM emission rate increases as the ash feed rate increases. Therefore, excessive particulates and overloading of APCS are prevented by setting limits on the maximum amount of ash in the feed streams.

Ash may consist of the following categories of materials:

- Sodium salts, especially sodium chloride
- Inorganic metal oxides
- Silicon-organic compounds, such as silanes or silicones

Exhibit 8.2.2-1, see page 6-59, shows step-by-step procedures for calculating or verifying the ash feed (input) rate. For facilities such as cement kilns and lightweight aggregate kilns that feed raw materials containing high amounts of ash, this parameter is not applicable. In these cases, excessive PM emission rates are controlled by placing a limit on maximum production rate.

The TBR reviewer should check that all feed streams have been accounted for and verify all ash feed rate calculations.

Check For:

- ❑ Ash concentration in each feed stream
- ❑ Flow rate of each stream containing ash
- ❑ Ash feed rate calculations in the appendix of the report

Example Section: Lois reviews the ash feed rate calculations presented in the report. During her review, she notes that the ash feed rate is based on the ash content of the liquid hazardous waste feed stream and the solid hazardous waste feed stream. The ash content of the nonhazardous viscous waste is not included.

Example Comments: Lois prepares a comment requiring the facility to include the ash content of all waste feedstreams—hazardous and nonhazardous—in their calculation of the ash feed rate. Ash from any source that is introduced into the combustion unit will affect the PM emission rate and APCS performance.

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EXHIBIT 8.2.2-1

ASH INPUT RATE CALCULATION

Rates of ash input to the boiler or furnace must be calculated for each run. Ash input rates for each stream will be calculated by multiplying the feed rate (pounds per hour) by the percent ash and dividing the result by 100. The total ash input rate is then obtained by summing ash input rates for each waste stream. (This calculation does not apply to cement or lightweight aggregate kilns.)

Summary:

(Line 1 x Line 2) ÷ 100 = Line 3 for each feed stream

Line 3 + Line 3 + Line 3 + ... = Line 4 at the bottom

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EXHIBIT 8.2.2-1 (Continued)
MODE:

Ash Inputs	Run Number/Date			Line No.
Feed Stream No. 1:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Feed Stream No. 2:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Feed Stream No. 3:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Feed Stream No. 4:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Feed Stream No. 5:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Feed Stream No. 6:				
Feed rate (lb/hr)				1
% Ash				2
Ash input (lb/hr)				3
Total Ash Input (lb/hr) =				4

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8.2.3 Verifying Chlorine Feed Rate

Regulations: 40 CFR Parts 266.103 and 266.107

Guidance: No specific references are applicable to this section of the manual.

Explanation: Typically, HCl and Cl_2 emission rates increase as the Cl_2 feed rate increases. The TBP should be reviewed to see whether all feed streams containing Cl_2 were sampled and analyzed during the actual trial burn test. Cl_2 feed rate calculations should be checked for accuracy. Exhibit 8.2.3-1, see page 6-62, shows step-by-step procedures for calculating or verifying the Cl_2 feed input rate.

Check For:

- ❑ Cl_2 concentration and flow rate of each waste stream containing Cl_2
- ❑ Cl_2 feed rate calculations in the appendix of the report
- ❑ Methods used to analyze for Cl_2

Example Situation: In reviewing the TBR, Clark notes that the feed rate of the liquid waste stream was 1,500 lb/hr with 15 percent Cl_2, and that the HCl feed rate was 22.5 lb/hr.

Example Action: Clark determines that the Cl_2 feed rate reported in the TBR is in error; the reported Cl_2 feed rate should be 225 lb/hr (that is, 1,500 lb/hr x 0.15 = 225 lb/hr). Clark asks that the facility correct this error in the TBR.

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EXHIBIT 8.2.3-1

CHLORINE INPUT RATE CALCULATION

Chlorine gas (Cl_2) input rates must be calculated for each run. Cl_2 input rates for each waste stream are calculated by multiplying the feed rate (pounds per hour) by the percent Cl_2 and dividing that result by 100. The total Cl_2 input rate is then obtained by summing the Cl_2 input rates for each waste stream.

Summary:

(Line 1 x Line 2) ÷ 100 = Line 3 for each feed stream

Line 3 + Line 3 + Line 3 + ... = Line 4 at the bottom

To convert pounds per hour to grams per second for Line 5:

(Line 4 x 453.6) ÷ 3,600 = Line 5

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EXHIBIT 8.2.3-1 (Continued)

MODE:

Chlorine Inputs	Run Number/Date			Line No.
Feed Stream No. 1:				
Feed rate (lb/hr)				1
% Chlorine (Cl_2)				2
Cl_2 input (lb/hr)				3
Feed Stream No. 2:				
Feed rate (lb/hr)				1
% Cl_2				2
Cl_2 input (lb/hr)				3
Feed Stream No. 3:				
Feed rate (lb/hr)				1
% Cl_2				2
Cl_2 input (lb/hr)				3
Feed Stream No. 4:				
Feed rate (lb/hr)				1
% Cl_2				2
Cl_2 input (lb/hr)				3
Feed Stream No. 5:				
Feed rate (lb/hr)				1
% Cl_2				2
Cl_2 input (lb/hr)				3
Feed Stream No. 6:				
Feed rate (lb/hr)				1
% Cl_2				2
Cl_2 input (lb/hr)				3
Total Cl_2 Input (lb/hr) =				4
Total Cl_2 Input (g/sec) =				5

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8.2.4 Verifying Hazardous Metal Feed Rate

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Typically, metal emission rates rise with increases in the feed rate of metal in waste feed streams. The TBP should be reviewed to see whether all metals potentially present in the feed streams were analyzed during the actual trial burn test. Metal feed rate calculations should be checked for accuracy.
Exhibit 8.2.4-1, see page 6-65, shows step-by-step procedures for calculating or verifying the metals feed rate.

Check For:

- ❑ Feed rate of each of the 10 BIF-regulated metals: antimony; barium; lead; mercury; silver; thallium; arsenic; beryllium; cadmium; and chromium; plus non-BIF-regulated metals: nickel; and selenium
- ❑ Total feed stream input rate
- ❑ Total hazardous waste feed stream input rate
- ❑ Total pumpable hazardous waste feed stream input rate
- ❑ Methods used to analyze metals
- ❑ Calculations based on feed rate and metals concentration

Example Situation: During the TBR review, Lois discovered that waste feed analysis data indicated that arsenic was present in three feed streams; however, calculations showed that arsenic came from only two streams.

Example Action: Lois asked that the facility (1) revise the arsenic feed rate reported values and affected calculations, and (2) present a summary of the effects that the increased arsenic feed rate would have on the proposed permit limits.

Notes: _____

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EXHIBIT 8.2.4-1

METAL CONCENTRATIONS IN FEEDS AND INPUT RATES

The following worksheet must be completed for each run. Each feed stream analyzed for metals is listed on Line 1. The concentration of each metal contained in each feed stream is obtained from laboratory analysis and entered on Line 3. To calculate the input rate for each metal (Line 4), multiply the concentration of the metal (Line 3) by the feed rate for the particular waste stream (Line 2). That product is then divided by 10^6 to convert to the proper units—pounds per hour. The first of the two metal input rate columns is calculated by summing input rates for that particular metal for all feed streams. That sum is then multiplied by 453.6 and divided by 3,600 to convert to grams per second for Column b.

Summary:

Line 4 = (Line 3 X Line 2) ÷ 10^6

Column a = sum of all input rates for each metal

Column b = ([Column a x 453.6] ÷ 3,600)

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EXHIBIT 8.2.4-1 (Continued)

MODE: _____

WORKSHEET 6. METAL CONCENTRATIONS IN FEEDS AND INPUT RATES									
RUN No: ___	Feed Stream #1	#2	#3	#4	#5	#6			Line No.
Date: _____									1
Feed Rate (lb/hr)							Metal Input Rate		2
Silver (Ag)							(a) (lb/hr)	(b) (g/sec)	
Concentration (ug/g)									3
Input rate (lb/hr)									4
Arsenic (As)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Barium (Ba)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Beryllium (Be)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Cadmium (Cd)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Chromium (Cr)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Mercury (Hg)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Lead (Pb)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Antimony (Sb)									
Concentration (ug/g)									3
Input rate (lb/hr)									4
Thallium (Tl)									
Concentration (ug/g)									3
Input rate (lb/hr)									4

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8.2.5 Verifying Combustion Unit Heat Input Rate

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, and Appendix F, Form 4.

Explanation: Temperature in the combustion unit is dependent on (among other variables such as moisture content and excess air) heat created from the input of the auxiliary fuel and waste feed stream. Because increased combustion zone temperatures may lead to increased metals vaporization which may, in turn, increase emissions of hazardous metals, it is necessary to measure the heat content of each feed stream. Exhibit 8.2.5-1, see page 6-68, shows step-by-step procedures for calculating or verifying the heat input rate.

Check For:

- ❑ Individual waste stream heat input rate
- ❑ Auxiliary fuel stream heat input rate
- ❑ Total heat input rate

Example Situation: In reviewing the TBR, Clark reads that the facility uses natural gas as auxiliary fuel, and an natural gas analysis supplied by the pipeline company includes the LHV and HHV for natural gas. A review of the heat input rate calculations indicated that the facility used the LHV for the heat input rate contribution from natural gas.

Example Action: Because the calculated heat input rate will be used to establish a maximum heat input rate limit, the use of the HHV will be more conservative, because for a given natural gas flow rate, the HHV will represent the maximum actual heat input. Clark asks that the facility revise the TBR to recalculate the heat input rate for natural gas using the HHV instead of the LHV.

Notes: _____

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EXHIBIT 8.2.5-1

HEAT INPUT RATE CALCULATION

Heat input rates to the boiler or furnace must be calculated for each run. Heat input rates for each feed stream are calculated by multiplying the feed rate (pounds per hour) by the heating value (British thermal units per pound). The total heat input rate is then obtained by summing heat input rates from each waste stream.

Summary:

(Line 1 x Line 2) = Line 3 for each feed stream

Line 3 + Line 3 + Line 3 + ... = Line 4 at the bottom

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EXHIBIT 8.2.5-1 (Continued)

MODE:

Heat Inputs	Run Number/Date			Line No.
Feed Stream No. 1:				
Feed rate (lb/hr)				1
HV British thermal unit (Btu) per pound				2
Heat input (Btu/hr)				3
Feed Stream No. 2:				
Feed rate (lb/hr)				1
HV (Btu/lb)				2
Heat input (Btu/hr)				3
Feed Stream No. 3:				
Feed rate (lb/hr)				1
HV (Btu/lb)				2
Heat input (Btu/hr)				3
Feed Stream No. 4:				
Feed rate (lb/hr)				1
HV (Btu/lb)				2
Heat input (Btu/hr)				3
Feed Stream No. 5:				
Feed rate (lb/hr)				1
HV (Btu/lb)				2
Heat input (Btu/hr)				3
Feed Stream No. 6:				
Feed rate (lb/hr)				1
HV (Btu/lb)				2
Heat input (Btu/hr)				3

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Total Heat Input (Btu/hr) =				4

8.3 REVIEWING SUMMARY OF PROCESS RESIDUALS SAMPLING

Regulations: 40 CFR Part 270.62

Guidance: U.S. EPA. 1989. "Hazardous Waste Incineration Measurement Guidance Manual." EPA-625-6-89-021. June. Section 3.4.6, Page 23.

Explanation: Samples of process residual streams (for example, bottom ash, scrubber effluent, or baghouse dust) are analyzed to determine the fate of POHCs during the DRE portion of the trial burn and metals during the high temperature test. In some cases, samples of these streams could be analyzed for metals or PICs to better assess the fate of these constituents in the system.

Check For:

- ❑ Process residual sampling location and sampling frequency
- ❑ Constituent/concentrations in each sample
- ❑ Sample compositing techniques
- ❑ Discussion of results compared to system performance

Example Situation: In reviewing the TBR, Lois notes that samples of bottom ash were not analyzed for metals and POHCs of concern.

Example Action: Bottom ash should have been analyzed for metals and POHCs of concern. Lois writes a comment asking the facility to explain and justify the failure to analyze the bottom ash sample.

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8.4 REVIEWING STACK GAS SAMPLING SUMMARY

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5, and Appendix F, Forms 6 through 10.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 5.

Explanation: This section of the TBR summarizes the types of stack gas sampling that were conducted during the trial burn.

Check For: The following subsections describe various aspects of stack gas sampling:

- ❑ Sampling and analysis of stack gas during the trial burn test for determination of specified parameters (see Section 8.4.1)
- ❑ Data tables for stack gas characteristics (see Section 8.4.2)
- ❑ Data tables for emission rates of constitutents of potential concern (see Section 8.4.3)

Example Situation: The subsections that follow contain example sections for each stack gas sampling parameter.

Example Comment: The subsections that follow subsections contain example comments for each stack gas sampling parameter.

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8.4.1 Reviewing Summary of Stack Gas Sampling Methods

Regulations: 40 CFR Part 60, Appendix A
40 CFR Part 266.103, Appendix IX to 40 CFR Part 266

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5, and Appendix F, Forms 6 through 10.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 5.

Explanation: This section of the manual summarizes the stack gas sampling methods used during the actual trial burn test. Sampling stack gas method procedures are described in 40 CFR Part 60, Appendix A; 40 CFR Part 266 Appendix IX; and in SW-846.

Check For: The reviewer should determine which methods were used for the indicated parameter. Examples include:

- ❑ 40 CFR Part 60, Appendix A, Method 1—Traverse Points (see Section 8.4.1.1)
- ❑ 40 CFR Part 60, Appendix A, Method 2—Velocity and Flow Rate (see Section 8.4.1.2)
- ❑ 40 CFR Part 60, Appendix A, Method 3—CO_2, O_2, Excess Air, Molecular Weight (see Section 8.4.1.3)
- ❑ 40 CFR Part 60, Appendix A, Method 4—Moisture Content (see Section 8.4.1.4)
- ❑ 40 CFR Part 60, Appendix A, Method 5, or Test Methods for Evaluating Solid Waste, SW-846 Method 0050—PM (see Section 8.4.1.5)
- ❑ Appendix IX to 40 CFR Part 266 or SW-846, Method 0050 or Method 0051—HCl and Cl_2 (see Section 8.4.1.5)
- ❑ Test Methods for Evaluating Solid Waste: SW-846 Method 0030 or SW-846 Method 0031—Volatile Organic Compounds (VOC) (see Section 8.4.1.6)
- ❑ Test Methods for Evaluating Solid Waste; SW-846 Method 0010—Semivolatile Organic Compounds (SVOC) (see Section 8.4.1.7)

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- ❑ 40 CFR Part 266, Appendix IX or SW-846, Method 23, or SW-846 Method 23A—PCDD/PCDF (see Section 8.4.1.8)
- ❑ 40 CFR Part 266, Appendix IX, Section 3.1, Method 0012, or SW-846 Method 0060—Metals (see Section 8.4.1.9)
- ❑ 40 CFR Part 266, Appendix IX, Section 3.2, Method 0013, or SW-846 Method 0061—Hexavalent Chromium (see Section 8.4.1.10)
- ❑ 40 CFRPart 266, Appendix IV, Section 3.5, or SW-846 Method 0011—Aldehydes and Ketones (see Section 8.4.1.11)
- ❑ SW-846 Method 0040—Organic Constituents from Combustion Sources using Tedlar® Bags (see Section 8.4.1.12)

Note that Methods 0010 and 0040 are used to collect samples for the measurement of unspeciated total organics (TO). Additionally, Methods 0010 and 23 or 0023A may be combined—additional guidance of these procedures are described in Component 4—How to Conduct Trial Burn Test Oversight.

Example Situation: Sampling methods listed in Appendix IX to 40 CFR Part 266 for BIF units should be used only for the compounds identified by the method. Clark uses Appendix IX for reference in reviewing TBRs. If certain parameter methods are not listed in Appendix IX to 40 CFR Part 266, Clark uses 40 CFR Part 60, Appendix A and SW-846, Test Methods for Evaluating Solid Waste.

Example Action: Clark reviews the TBP and verifies that proposed sampling methods were used during the actual trial burn test.

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8.4.1.1 Verifying Traverse Points

Regulation: Title 40 CFR Part 60, Appendix A, U.S. EPA Method 1

Guidance: No specific references are applicable to this section of the manual.

Explanation: Title 40 CFR Part 60, Appendix A, U.S. EPA Method 1 should be followed for sample and velocity traverses. It should be used for all runs of all test conditions. Stack gas is sampled at each traverse point to accurately measure the velocity and flow rate of stack gas. U.S. EPA Method 1 traverse points selected should meet the minimum requirements of; if these requirements cannot be met, additional traverse points can be used for sampling as long as cyclonic flow conditions are not present within the stack.

Check For:

- ❑ Stack and duct diameter or dimensions
- ❑ Numbers of traverse points selected for PM and velocity traverses (based on stack dimensions, location of sampling ports, and upstream and downstream disturbance)
- ❑ Absence of cyclonic flow

Example Section: The following situation is encountered in the field:

Stack diameter = 18 inches
Duct diameter upstream from flow disturbance to sample port = 1
Duct diameters downstream from flow disturbance to sample port = 4

Method 1 calculations indicate the following sample port locations:

Duct diameters upstream from flow disturbance to sample port = 2
Duct diameters downstream from flow disturbance to sample port = 8

Stack Diameter	No. of Traverse Points
>2 feet	12
1 to 2 feet	8
–	9

Example Comments: Since the sampling port location does not meet the standard Method 1 conditions, additional traverse points must be used, and the absence of cyclonic flow must be verified. Clark checks to ensure that the sampling was conducted using 24 traverse points and that the absence of cyclonic flow was verified.

Notes: _____

8.4.1.2 Verifying Stack Gas Velocity and Flow Determination

Regulation: 40 CFR Part 60 Appendix A, U.S. EPA Method 2

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 5, and Appendix F, Form 6.

Explanation: The average gas velocity in a stack is determined from the gas density and from the measurement of the velocity head with a Type S pitot tube.

The stack gas velocity calculation method and all equations are provided in 40 CFR Part 60, Appendix A, Method 2 (see Section 5). It should be used for all runs of all test conditions.

Exhibit 8.4.1.2-1, see page 6-76 provides an example Method 0050 field data sheet form. Exhibit 8.4.1.2-2, see page 6-79, shows step-by-step procedures for calculating velocity and flow rate.

Check For:

- ❑ Type of pitot tube
- ❑ Pitot tube coefficient
- ❑ Data sheet for velocity traverse (for each traverse point there should be a measurement of the velocity head and stack temperature)
- ❑ Sampling time (minimum of 2 hours for a composite sample per run)
- ❑ Calculation of stack gas velocity under (1) actual and standard temperature and pressure (STP) conditions, and (2) corrected to 7 percent O_2
- ❑ Calculation of stack gas flow rate under (1) actual and STP conditions, and (2) corrected to 7 percent O_2

Example Situation: In reviewing the TBR field logsheet, Lois notes that pitot tube 001 was used with a pitot tube coefficient of 0.84, whereas the pitot tube calibration data package indicates the coefficient for pitot tube 001 is 0.83.

Example Action: Because the calibration data package shows a coefficient of 0.83 for pitot tube 001, this value should be used for calculation purposes. Lois asks that the facility revise the calculations based on the revised coefficient.

Notes: _____

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EXHIBIT 8.4.1.2-1
EXAMPLE METHOD 0050 DATA FORM

[redacted]

STACK TEST CALCULATIONS

Project:	[redacted]	Barom. Psr.:	30.27		Calculated
Project No:		Static Psr.:	-0.08	Ps:	30.264
Source:	Waste Boiler (MM5)	Delta H @:	1.7497	As:	8.727
Run No.:	6C	Gamma:	0.9906	An:	0.000524
Date	[redacted]	Pitot Coef.:	0.84		
Sample Volume:	76.825	Stack Dia.:	40 ,in.		
Sample Time:	144	Nozzle Dia.:	0.31 ,in.		
O2 Conc.:	4.2	H2O Gain:	222.3 ,ml		
CO2 Conc.:	12	Part. Weight:	,g		

TRAVERSE POINT NUMBER	VELOCITY DELTA P		DELTA H	DRY GAS METER TEMPERATURE		STACK TEMP.
	Actual	Sq. Root		Inlet	Outlet	
1	0.11	0.331662	0.59	73	72	287
2	0.1	0.316228	0.53	74	73	275
3	0.12	0.34641	0.64	76	74	290
4	0.15	0.387298	0.8	78	75	298
5	0.13	0.360555	0.7	79	75	300
6	0.13	0.360555	0.7	79	76	299
7	0.16	0.4	0.86	81	77	303
8	0.21	0.458258	1.12	82	77	304
9	0.26	0.509902	1.39	82	77	304
10	0.29	0.538516	1.55	82	76	303
11	0.28	0.52915	1.5	82	77	304
12	0.26	0.509902	1.39	82	77	304
13	0.17	0.412311	0.91	80	77	270
14	0.18	0.424264	0.96	81	78	270
15	0.19	0.43589	1.02	81	77	276
16	0.24	0.489898	1.28	82	77	301
17	0.23	0.479583	1.23	83	77	304
18	0.21	0.458258	1.12	83	77	304
19	0.16	0.4	0.86	83	77	303
20	0.14	0.374166	0.75	81	77	305
21	0.15	0.387298	0.8	80	75	303
22	0.17	0.412311	0.91	81	77	305
23	0.14	0.374166	0.75	81	76	303
24	0.13	0.360555	0.7	80	76	302
AVERAGE	0.179583	0.419047	0.9608333	78.1875		296.5417

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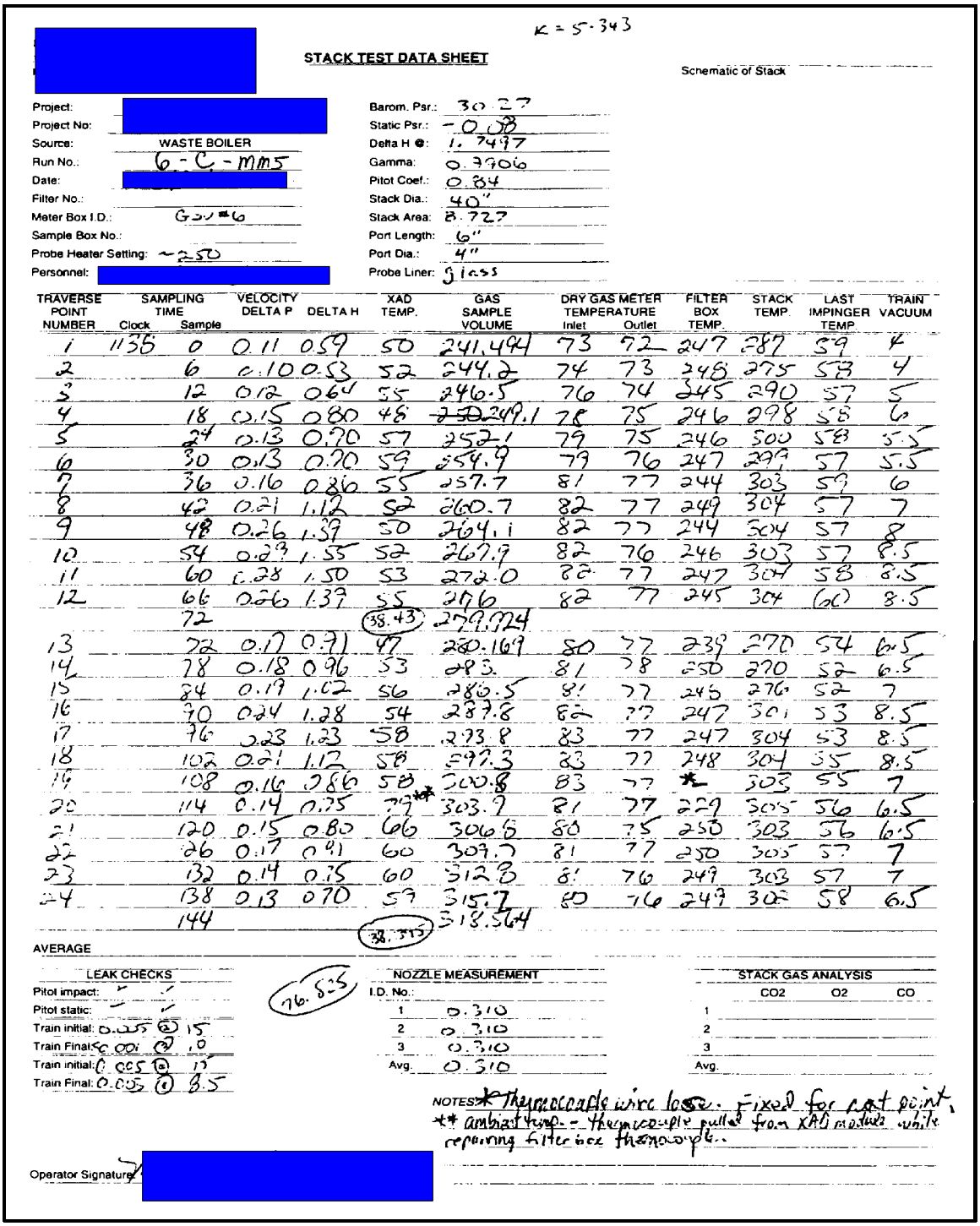
EXHIBIT 8.4.1.2-1 (Continued)
EXAMPLE METHOD 0050 DATA FORM



K = 5.343

[redacted]

STACK TEST DATA SHEET

Schematic of Stack

Project: [redacted]
Project No:
Source: WASTE BOILER
Run No.: 6-C-MM5
Date: [redacted]
Filter No.:
Meter Box I.D.: GJ #6
Sample Box No.:
Probe Heater Setting: ~250
Personnel: [redacted]

Barom. Psr.: 30.27
Static Psr.: -0.08
Delta H @: 1.7497
Gamma: 0.9906
Pitot Coef.: 0.84
Stack Dia.: 40"
Stack Area: 8.727
Port Length: 6"
Port Dia.: 4"
Probe Liner: Glass

TRAVERSE POINT NUMBER	SAMPLING TIME Clock	SAMPLING TIME Sample	VELOCITY DELTA P	DELTA H	XAD TEMP.	GAS SAMPLE VOLUME	DRY GAS METER TEMPERATURE Inlet	DRY GAS METER TEMPERATURE Outlet	FILTER BOX TEMP.	STACK TEMP.	LAST IMPINGER TEMP.	TRAIN VACUUM
1	1135	0	0.11	0.59	50	241.444	73	72	247	287	59	K
2		6	0.10	0.53	52	244.2	74	73	248	275	58	4
3		12	0.12	0.64	55	246.5	76	74	245	290	57	5
4		18	0.15	0.80	48	~~250~~ 249.1	78	75	246	298	58	6
5		24	0.13	0.70	57	252.1	79	75	246	500	58	5.5
6		30	0.13	0.70	59	254.9	79	76	247	299	57	5.5
7		36	0.16	0.86	55	257.7	81	77	244	303	59	6
8		42	0.21	1.12	52	260.7	82	77	249	304	57	7
9		48	0.26	1.39	50	264.1	82	77	244	304	57	8
10		54	0.29	1.55	52	267.7	82	76	246	303	57	8.5
11		60	0.28	1.50	53	272.0	82	77	247	304	58	8.5
12		66	0.26	1.39	55	276	82	77	245	304	(60)	8.5
		72			(38.43)	279.724						
13		72	0.17	0.91	47	~~280~~.169	80	77	239	270	54	6.5
14		78	0.18	0.96	53	~~283~~	81	78	~~250~~	270	52	6.5
15		84	0.19	1.02	56	286.5	81	77	245	276	52	7
16		90	0.24	1.28	54	287.8	82	77	247	301	53	8.5
17		96	0.23	1.23	58	293.8	83	77	247	304	53	8.5
18		102	0.21	1.12	58	~~297~~.3	83	77	248	304	55	8.5
19		108	0.16	0.86	58	~~300~~.8	83	77	*	303	55	7
20		114	0.14	0.75	79**	303.9	81	77	229	305	56	6.5
21		120	0.15	0.80	66	306.6	80	75	250	303	56	6.5
22		126	0.17	0.91	60	309.7	81	77	250	305	57	7
23		132	0.14	0.75	60	312.8	81	76	249	303	57	7
24		138	0.13	0.70	59	315.7	80	76	249	302	58	6.5
		144			(38.313)	318.564						
AVERAGE												

(76.825)

LEAK CHECKS

Pitot impact:	✓	✓
Pitot static:	✓	✓
Train initial:	0.005	@ 15
Train Final:	0.001	@ 10
Train initial:	0.005	@ 17
Train Final:	0.005	@ 8.5

NOZZLE MEASUREMENT

I.D. No.:	
1	0.310
2	0.310
3	0.310
Avg.	0.310

STACK GAS ANALYSIS

	CO2	O2	CO
1			
2			
3			
Avg.			

NOTES: * Thermocouple wire loose. Fixed for next point.
** ambient temp. - Thermocouple pulled from XAD moisture while replacing filter since thermocouple..

Operator Signature: [redacted]

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EXHIBIT 8.4.1 2-1 (Continued)
EXAMPLE METHOD 0050 DATA FORM

STACK TEST IMPINGER LAB DATA SHEET

[redacted]

PROJECT: [redacted]
SOURCE:
TRAIN I.D.: MM5-C
COLLECTED BY: [redacted]

JOB NO.: [redacted]
DATE:
TEST NO.: 6
CHKD. BY:

CONDENSATION

IMPINGER NO.	INITIAL VOL., ml/g	FINAL VOL., ml/g	NET GAIN, ml/g
1	388.2	595.2	207.0
2	701.3	698.8	-2.5
3	662.9	673.0	0.1
4	604.8	605.8	1.0
5	779.1	786.8	16.7
6			
7			
TOTAL			222.3

COMMENTS:

US EPA ARCHIVE DOCUMENT

EXHIBIT 8.4.1.2-2
STACK GAS VELOCITY CALCULATION

RAW DATA INPUT
FOR
EPA METHOD 0050 FLOW RATE CALCULATIONS

Plant Name:	XYZ Company
Location:	Anywhere, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Po	-	Average Meter Differential Pressure	0.18	in. H_2O
Pb	-	Barometric Pressure	30.27	in. Hg
Tm	-	Average Dry Gas Meter Temperature	78.188	°F
DGMC	-	Dry Gas Meter Correction Factor	0.9906	Dimensionless
Vlcg	-	Total Condensate Collected	222.3	grams
Vm	-	Dry Gas Meter Sample Volume	76.825	dcf
T	-	Sampling Time Duration	144.0	min
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	12.00	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	4.20	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
Dn	-	Nozzle Diameter	0.3100	in.
Cp	-	Pitot Tube Coefficient	0.84	Dimensionless
Dp	-	Avg. Sq. Root of Velocity Head	0.4190	in. $H_2O^{0.5}$
Ts	-	Average Stack Gas Temperature	296.5	°F
Sp	-	Static Pressure of Gas Stream	-0.08	in. H_2O
D	-	Stack Diameter	40.00	in.

US EPA ARCHIVE DOCUMENT

EXHIBIT 8.4.1.2-2 (Continued)
STACK GAS VELOCITY CALCULATION

VELOCITY AND VOLUMETRIC FLOW RATE DETERMINATION

COMPANY:	**XYZ Company**	**CONDITION:**	**NORMAL**
LOCATION:	**Anywhere, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Cp	-	Pitot Tube Coefficient	Dimensionless
Vs	-	Stack Gas Velocity	ft/sec
Qsd	-	Volumetric Flow Rate at Standard Conditions, Dry Basis	dscfm
Qact	-	Volumetric Flow Rate, Wet Basis	cfm
Bws	-	Moisture Content	mole fraction
Dp	-	Avg. Sq. Root of Velocity Head	in. $H_2O^{0.5}$
Pb	-	Barometric Pressure	in. Hg
Kp	-	Constant = 85.49 (ft)(lb/lb-mol)(in.Hg^0.5)/(s)(°R)(in.H2O)	
Ts	-	Average Stack Gas Temperature	°R
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Sp	-	Static Pressure of Gas Stream	in. H_2O
Tstd	-	Absolute Standard Temperature (528)	°R
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
CSA	-	Stack Cross-Sectional Area	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Conversion Factor (60)	sec/min
Pi	-	Constant (3.1416)	Dimensionless
D	-	Stack Diameter	in.

TEST DATA

Variable	Data	Variable	Data	Variable	Data
Ms =	28.616	Dp =	0.4190	Cp =	0.84
Bws =	0.1218	Pb =	30.27	D =	40.00
Sp =	-0.08	Ts =	756.5		

CALCULATIONS

Ps = Pb + (Sp/K1) = 30.27 + (-0.08/13.6) = **30.26 in. Hg**

Vs = (Kp)(Cp)(Dp)[(Ts)/(Ms)(Ps)]^0.5

Vs = (85.49)(0.84)(0.4190)[756.5/(28.616)(30.26)]^0.5 = **28.13 ft/sec**

CSA = (Pi)(D^2)/[(4)(144)] = (3.1416)(40.00)^2/[(4)(144)] = **8.73 ft^2**

Qact = (Vs)(CSA)(K2) = (28.13)(8.73)(60) = **14734.5 cfm**

$$Qsd = \frac{(Qact)(1-Bws)(Tstd)(Ps)}{(Ts)(Pstd)} = \frac{(14734.5)(1-0.1218)(528)(30.26)}{(756.5)(29.92)}$$

Qsd = **9134.0 dscfm**

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EXHIBIT 8.4.1.2-2 (Continued)
STACK GAS VELOCITY CALCULATION

FLOW RATE DATA SUMMARY

COMPANY:	**XYZ Company**	**CONDITION:**	**NORMAL**
LOCATION:	**Anywhere, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable	Definition	Value	Units
	INPUT DATA SUMMARY		
$\%CO_2$	Carbon Dioxide Concentration, Dry Basis	12.00	% Volume
%CO	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
$\%O_2$	Oxygen Concentration, Dry Basis	4.20	% Volume
$\%N_2$	Nitrogen Concentration, Dry Basis (gas balance)	83.80	% Volume
Pb	Barometric Pressure	30.27	in. Hg
Sp	Static Pressure of Gas Stream	-0.08	in. H_2O
Po	Average Meter Differential Pressure	0.18	in. H_2O
Ts	Average Stack Gas Temperature	756.5	°R
Tm	Average Dry Gas Meter Temperature	538.2	°R
Vlcg	Total Condensate Collected	222.3	grams
Vm	Dry Gas Meter Sample Volume	76.825	dcf
DGMC	Dry Gas Meter Correction Factor	0.991	Dimensionless
Dp	Avg. Sq. Root of Velocity Head	0.419047	in. $H_2O^{0.5}$
Cp	Pitot Tube Coefficient	0.84	Dimensionless
D	Stack Diameter	40.00	in.
	RESULTS SUMMARY		
Md	Sample Gas Molecular Weight, Dry Basis	30.088	lb/lb-mole
Ms	Sample Gas Molecular Weight, Wet Basis	28.616	lb/lb-mole
Ps	Absolute Stack Gas Pressure	30.26	in. Hg
Pm	Absolute Dry Gas Meter Pressure	30.28	in. Hg
Vmstd	Dry Gas Meter Sample Volume, at Standard Conditions	75.589	dscf
Vwstd	Volume of Water Vapor Collected, at Standard Conditions	10.481	scf
Bws	Moisture Content	0.1218	mole fraction
Bwd	Moisture Content	12.18	% Volume
CSA	Stack Cross-Sectional Area	8.73	ft^2
Vs	Stack Gas Velocity	28.13	ft/sec
Qact	Volumetric Flow Rate, Wet Basis	14734.5	cfm
Qsd	Volumetric Flow Rate, at Standard Conditions, Dry Basis	9134.0	dscfm
I	Isokinetic Sampling Rate	95.74	%

US EPA ARCHIVE DOCUMENT

EXHIBIT 8.4.1.2-2 (Continued)
STACK GAS VELOCITY CALCULATION

ISOKINETIC SAMPLING DETERMINATION

COMPANY:	**XYZ Company**	**CONDITION:**	**NORMAL**
LOCATION:	**Anywhere, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable			Units
I	-	Isokinetic Sampling Rate	%
Ts	-	Average Stack Gas Temperature	°R
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vs	-	Stack Gas Velocity	ft/sec
T	-	Sampling Time Duration	minutes
An	-	Cross-Sectional Area of Nozzle	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
Dn	-	Nozzle Diameter	in.
Vlcg	-	Total Condensate Collected	grams
Pi	-	Constant (3.1416)	dimensionless
K1	-	Conversion Factor (144)	in^2/ft^2
K2	-	Conversion Factor (100)	Percent
K3	-	Conversion Factor (17.64)	°R/in. Hg
K4	-	Conversion Factor (0.002669)	$Hg\text{-}ft^3/ml\text{-}°R$
K5	-	Conversion Factor (60)	sec/min

TEST DATA

Variable		Data	Variable	Data	Variable	Data
Vmstd	=	75.589	Ps =	30.26	K2 =	100
Vs	=	28.13	T =	144.0	K3 =	17.64
Vlcg	=	222.3	Dn =	0.310	K4 =	0.002669
Ts	=	756.5	K1 =	144	K5 =	60

CALCULATIONS

An = (Pi)(Dn)^2/[(4)(K1)]

An = (3.1416)(0.310)^2/[(4)(144)] = **0.000524 ft^2**

$$I = \frac{(K2)(Ts)[(Vmstd/K3) + (K4)(Vlcg)]}{(K5)(Vs)(An)(Ps)(T)}$$

$$I = \frac{(100)(756.5)[(75.589/17.64) + (0.002669)(222.30)]}{(60)(28.13)(0.000524)(30.26)(144.0)} = \textbf{95.74 \%}$$

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8.4.1.3 Verifying Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Molecular Weight

Regulation: 40 CFR Part 60, Appendix A, Method 3

Guidance: No specific references are applicable to this section of the manual.

Explanation: A gas sample is extracted from a stack using one of the following techniques: single-point grab sampling; single-point integrated sampling; or multipoint integrated sampling. The gas sample is analyzed for CO, CO_2, and O_2. An orsat or fyrite analyzer is used to measure dry molecular weight. This method should be used for all runs of test conditions.

Exhibit 8.4.1.3-1, see page 6-84, shows step-by-step procedures for calculating molecular weight.

Check For:

- ❑ Sampling method
- ❑ Gas analysis method (Orsat or Fyrite)
- ❑ Sampling time (minimum of 2 hours for composite sample per run)
- ❑ Percent of CO, CO_2, and O_2
- ❑ Molecular-weight calculations for each run

Example Situation: In reviewing the TBR, Lois notes that the average CO levels during the first run was 90 measured as ppmv; however, the TBR molecular-weight calculations sheet shows the percent CO value as zero.

Example Action: The TBR molecular-weight calculations sheet for the first run should reflect the actual concentration of 90 ppmv rather than the 0 percent that is indicated. Although the percentage value will be very small, Lois asks that the facility recalculate an accurate percent CO value. Percent CO is calculated as follows:

$$\frac{90\ parts\ CO}{10^6\ parts\ total}\ x\ 100 = 0.009\ percent\ CO$$

Notes: _____

_____

_____

US EPA ARCHIVE DOCUMENT

EXHIBIT 8.4.1.3-1
MOLECULAR WEIGHT DETERMINATION

MOLECULAR WEIGHT DETERMINATION

COMPANY:	**XYZ Company**	**CONDITION:**	**NORMAL**
LOCATION:	**Anywhere, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Md	-	Sample Gas Molecular Weight, Dry Basis	lb/lb-mole
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Bws	-	Moisture Content	mole fraction
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	% Volume
$\%N_2$	-	Nitrogen Concentration, Dry Basis (gas balance)	% Volume
0.32	-	Molecular Weight of Oxygen, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Carbon Monoxide, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Nitrogen, divided by 100%	lb/lb-mole
0.44	-	Molecular Weight of Carbon Dioxide, divided by 100%	lb/lb-mole
18.0	-	Molecular Weight of Water	lb/lb-mole

TEST DATA

Variable	Data	Variable	Data
Bws =	0.1218	%CO =	0.00
$\%N_2$ =	83.80	$\%CO_2$ =	12.00
$\%O_2$ =	4.20		

CALCULATIONS

Md = $(0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$

Md = $(0.44)(12.00) + (0.32)(4.20) + (0.28)(83.80 + 0.00)$

Md = **30.088 lb/lb-mol**

Ms = $(Md)(1 - Bws) + (18.0)(Bws)$

Ms = $(30.088)(1 - 0.1218) + (18.0)(0.1218)$

Ms = **28.616 lb/lb-mol**

US EPA ARCHIVE DOCUMENT

8.4.1.4 Verifying Method of Determining Moisture in Stack Gas

Regulations: 40 CFR Part 60, Appendix A, EPA Method 4

Guidance: No specific references are applicable to this section of the manual.

Explanation: A gas sample is extracted from the stack at a constant rate; moisture is removed from the sample stream and calculated either volumetrically or gravimetrically (GRAV). Title 40 CFR Part 60, Appendix A, Method 4 lists detailed procedures and the method for calculating moisture content in the stack gas. This method should be used for all runs for all test conditions. Exhibit 8.4.1.4-1, see page 6-86, shows step-by-step procedures for calculating moisture content in flue gas.

Field data logsheet parameters included under "Check For" should be verified, including the average value for each parameter. Calculations for each run should also be verified for accuracy.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time stack temperature, orifice meter differential (Δ H); meter reading for gas volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger])
- ❑ Sampling time (minimum of 2 hours per composite sample per run)
- ❑ Moisture calculations

Example Situation: Clark reads in the TBR field logsheet that Meter 2 was used with a dry-gas meter calibration factor of 1.00273, whereas the dry-gas meter calibration data package indicates this value to be 1.0273.

Example Action: Because the calibration data package shows a dry-gas meter calibration factor of 1.0273 for Meter 2, Clark asks that the facility use this value for calculations.

Notes: _____

_____

_____

US EPA ARCHIVE DOCUMENT

EXHIBIT 8.4.1.4-1
MOISTURE CONTENT DETERMINATION

MOISTURE CONTENT AND SAMPLE VOLUME CORRECTION CALCULATIONS

COMPANY:	**XYZ Company**	**CONDITION:**	**NORMAL**
LOCATION:	**Anywhere, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Pm	-	Absolute Dry Gas Meter Pressure	in. Hg
Po	-	Average Meter Differential Pressure	in. H_2O
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
Pb	-	Barometric Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Standard Volume H_2O Vapor/Unit Weight Liquid (0.04715)	ft^3/g
Tm	-	Average Dry Gas Meter Temperature	°R
Tstd	-	Absolute Standard Temperature (528)	°R
DGMC	-	Dry Gas Meter Correction Factor	Dimensionless
Vlcg	-	Total Condensate Collected	grams
Vm	-	Dry Gas Meter Sample Volume	dcf
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vwstd	-	Volume of Water Vapor Collected, at Standard Conditions	scf
Bws	-	Moisture Content	mole fraction
Bwd	-	Moisture Content	% Volume

TEST DATA

Variable	Data	Variable	Data
Pb =	30.27	Tm =	538.2
Vm =	76.825	Po =	0.18
Vlcg=	222.3	DGMC =	0.991

CALCULATIONS

Pm	=	Pb + (Po/K1) =	30.27 + (0.18/13.6) =	**30.28 in. Hg**
Vmstd	=	$\frac{(Vm)(DGMC)(Pm)(Tstd)}{(Pstd)(Tm)}$ =	$\frac{(76.825)(0.991)(30.28)(528)}{(29.92)(538.2)}$ =	**75.589 dscf**
Vwstd	=	(K2)(Vlcg) =	(0.04715)(222.3) =	**10.481 scf**
Bws	=	$\frac{(Vwstd)}{(Vwstd) + (Vmstd)}$ =	$\frac{10.481}{(10.481)+(75.589)}$ =	**0.1218**
Bwd	=	(Bws)(100 %) =	(0.1218)(100%) =	**12.18 % Volume**

US EPA ARCHIVE DOCUMENT

8.4.1.5 Verifying Method of Determining Particulates, Hydrogen Chloride, and Chlorine

Regulation: 40 CFR Part 60, Appendix A, Method 5
SW-846, Method 0050 or Method 0051

Guidance: No specific references are applicable to this section of the manual.

Explanation: Stack gases are sampled isokinetically from the source to collect PM on a glass filter maintained at a temperature of 248 ± 25°F, and to collect HCl and Cl_2 gas in absorbing solutions. This method is typically used during all runs of all test conditions. Particulate mass, which includes any material that condenses at or above the filtration temperature, is calculated GRAV after combined water is removed. The HCl content of the absorbing solutions is quantitatively calculated at the laboratory using ion chromatography.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]). Ensure data are collected at consistent interval throughout run—for example, every 5 minutes.
- ❑ Sampling train arrangement, as suggested in U.S. EPA Methods 0050 and 0051
- ❑ Proper temperature maintenance (probe and filter at 248 ± 25°F, train exit gas less than 68°F)
- ❑ Sampling time (minimum of 2 hours per composite sample per run)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: Title 40 CFR Part 60, Appendix A, Method 5 lists the procedure and methods for calculating particulate concentration. U.S. EPA Method 0050 or 0051 should be used to analyze for HCl and Cl_2.

Example Action: Clark reviews the TBR to see whether the method used for PM, HCl, and Cl_2 conforms to the methods specified in the approved TBP; Clark also verifies the sampling train configuration. Sections 11.3.1 and 11.3.2 of this component explain how to review PM, HCl, and Cl_2 emission rates.

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8.4.1.6 Verifying Volatile Organic Sampling Train Sampling Method for Determination of Volatile Organics

Regulations: SW-846 Method 0030

Guidance: No specific references are applicable to this section of the manual.

Explanation: A volatile organic sampling train (VOST) is used to sample VOCs or POHCs (VOC designated for measurement and calculation of destruction and removal efficiency) from stack gas samples. This method is typically used during the DRE and risk burn test conditions. A known volume of air is collected and passed through an absorbent medium (such as charcoal or Tenax®) contained in glass tubes. These tubes or cartridges are sent to the laboratory for POHC analysis.

Check For:

- ❑ Field data sheet showing sample volume and sampling duration (see Section IV of U.S. EPA 1989 Checklist for Reviewing RCRA TBRs for more details)
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0030 or U.S. EPA Method 0031
- ❑ Minimum sampling time of 2 hours or 20 to 40 minutes per set of VOST cartridges, with three to four sets VOST cartridges per run (typically, four sets are collected, and three are analyzed; with one set saved as a back up)
- ❑ Calculations showing sample volumes corrected to standard conditions
- ❑ Whether the samples were analyzed for the target VOC list identified in the TBP (the VOC analyte list should include, at a minimum, all target analytes for SW-846 U.S. EPA Method 3542)
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: U.S. EPA Method 0030 lists the procedure for conducting VOST sampling. This method should have been followed while conducting VOST sampling.

Example Action: Clark reviews the TBR to see whether the VOST sampling method conforms to the approved TBP. Clark also verifies the sampling train configuration. Sections 11.3.4 and 11.3.6 of this component explain how to review POHC and VOC emissions rates.

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8.4.1.7 Verifying Semivolatile Organic Sampling Train Sampling Method for Determination of Semivolatile Organics

Regulation: SW-846 U.S. EPA Method 0010

Guidance: No specific references are applicable to this section of the manual.

Explanation: An EPA modified Method 5 train—specified as U.S. EPA Method 0010—is used to collect samples of SVOCs present in stack gas. This method is typically used during all runs of the DRE and risk burn test conditions. A known volume of air is collected and passed through a series of adsorbent medium (including various impinger solutions and adsorbent resins such as XAD). The various solutions and resin tubes recovered from the sampling train are sent to the laboratory for SVOC analysis (both speciated analysis using Method 8270B and unspeciated, using the procedure outlined in the Method for Total Organics).

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0010
- ❑ Maintenance of proper sampling train temperatures
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Minimum sampling time of 2 hours per run
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

See Section IV of the U.S. EPA 1989 Checklist for Reviewing RCRA TBRs for more details.

Example Situation: U.S. EPA Method 0010, lists the procedures for conducting a SVOC sampling train. This method should have been followed while collecting SVOC samples.

Example Action: Lois reviews the TBR to see whether the method used to collect SVOC samples conforms to the approved TBP. Lois also verified the sampling train configuration. Sections 11.3.5 and 11.3.6 of this component explain how to review SVOC emission rates.

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8.4.1.8 Verifying Sampling Method for Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans

Regulation: 40 CFR Part 266, Appendix IX, Method 23
SW-846 Method 0023A

Guidance: No specific references are applicable to this section of the manual.

Explanation: Most combustion units have the potential to emit PCDDs and PCDFs; especially those using dry PM control devices. This method is typically used for all runs of the test condition used to collect risk assessment data. Stack gases are sampled isokinetically to collect PCDD/PCDF on a particulate filter; XAD-2 adsorbent resin, and adsorbent impinger solutions. Samples recovered from the sampling train are analyzed in the laboratory for PCDD/PCDF content. This method may be combined with a Method 0010 sampling train. Additional guidelines regarding sampling train operation and recovery are described in Component 4—How to Conduct Trial Burn Test Oversight.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Methods 23 and 0023A
- ❑ Maintenance of probe exit temperature and filter compartment at 248 ± 25°F during sampling
- ❑ Whether gas enters sorbent tube module at or below 68°F
- ❑ Minimum sampling time of 3 hours per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ PCDD/PCDF emission calculations
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: U.S. EPA Method 23, 40 CFR Part 266, Appendix IX, lists procedures for collecting PCDD/PCDF samples. Section 11.3.7 of this component explains how to review PCDD/PCDF emission rates.

Example Action: Clark reviews the TBR to see whether the method used to collect PCDD/PCDF samples conforms to the approved TBP. Clark also verifies the sampling train configuration.

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8.4.1.9 Verifying Sampling Method for Multiple Metals

Regulations: 40 CFR Part 266, Appendix IX, Section 3.1, Method 0012
SW-846 Method 0060

Guidance: No specific references are applicable to this section of the manual.

Explanation: Stack gases are sampled isokinetically to collect metals —antimony, arsenic, barium, beryllium, cadmium, total chromium, nickel, lead, mercury, selenium, silver, and thallium—on a filter and in absorbing solutions. This method is typically used during the high temperature and risk burn test conditions. Metals content of the samples are quantitatively determined at the laboratory using inductively coupled plasma or atomic adsorption spectroscopy.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in referenced method
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Minimum sampling time of about 3 hours composite per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Metals emission rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: Titile 40 CFR Part 266 Appendix IX, Section 3.1 lists procedures for collecting multiple metals samples. Section 11.3.3 of this component explains how to review multiple metals emission rates.

Example Action: Lois reviews the TBR to see whether the method used for multiple metals collection conforms to the approved TBP. Lois also verifies the sampling train configuration.

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8.4.1.10 Verifying Sampling Method for Hexavalent Chromium

Regulations: 40 CFR Part 266 Appendix IX, Section 3.2, Method 0013
SW-846 Method 0061

Guidance: No specific references are applicable to this section of the manual.

Explanation: This method is typically used during all runs of the high temperature and risk burn conditions, if necessary. Stack gases are sampled isokinetically to collect hexavalent chromium in an absorbing solution. The hexavalent chromium content of the sample is quantitatively determined using ion chromatography at the laboratory.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in referenced method
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Minimum sampling time of about 3 hours per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Hexavalent chromium emission rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: Title 40 CFR Part 266, Appendix IX, Section 3.2 lists procedures for collecting hexavalent chromium samples. Section 11.3.3 of this component explains how to review multiple metals emission rates.

Example Action: Clark reviews the TBR to see whether the method used for hexavalent chromium conforms to the approved TBP. He also verifies the sampling train configuration.

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8.4.1.11 Verifying Sampling Method for Aldehydes and Ketones

Regulations: 40 CFR Part 266 Appendix IX, Section 3.5
SW-846 U.S. EPA Method 0011

Guidance: No specific references are applicable to this section of the manual.

Explanation: This method is typically used during all runs of the risk burn test condition, if necessary. Stack gases are sampled isokinetically to collect aldehydes and ketones in an absorbing solution. The samples are analyzed using U.S. EPA Method 8315, high performance liquid chromatography.

Check For:

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0011
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Minimum sampling time of 2 hours per run
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: SW846 Method 0011 lists procedures for collecting aldehydes and ketones.

Example Action: Clark reviews the TBR to verify that modifications to Method 0011, incorporated into the approved TBP, were followed during the testing activities.

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8.4.1.12 Verifying Sampling Method for Organic Constituents Using Tedlar® Bags

Regulations: SW-846 Method 0040

Guidance: No specific references are applicable to this section of the manual.

Explanation: This method is used during all runs of the risk burn test condition. A Tedlar® bas is used to collect low-molecular weight PICs. A stack gas sample is drawn into the bag. The bag contents are analyzed for total unspeciated organics by an on-site field GC.

Check For:

- ❑ Field data sheets (stack gas velocity head, stack gas temperature, condition temperatures)
- ❑ Sampling train configuration, as outlined in Method 0040
- ❑ Constant sampling rate
- ❑ Minimum sample time of 60 minutes
- ❑ Consistency with observations documented in the trial burn oversight report

Example Situation: Lois notes that during the Method 0040 sampling for Run 3, the stack gas temperature ranged between 280 and 300°F. Because the probe temperature exceeded 284°F, Lois checked to see how the sampling probe was cooled, but could find no discussion regarding this issue.

Example Action: Although Lois could not find any discussion of probe cooling activities, she noted during her review that although the stack gas temperature had exceeded 284°F, the sampling probe and filter box had been maintained between 266 and 284°F, in accordance with the method requirements. Since the proper temperature range had been maintained, Lois did not anticipate a significant impact on the results, however, she asked the facility to clarify whether probe cooling activities had been used during the trial burn test.

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8.4.2 Reviewing Data Tables For Stack Gas Characteristics

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Generally, tables are included in the TBR to summarize the stack gas characteristics for each sampling method (particulate sampling train, metals sampling train, hexavalent chromium sampling train, VOST, SVOC sampling train, and PCDD/PCDF sampling train). These summary tables are prepared on the basis of field data sheets and emission calculations presented in the stack test report.

Check For:

- ❑ Summary table for each isokinetic sampling train, including sampling time, corrected sample volume, stack gas temperature, moisture content, CO_2 percent, O_2 percent, stack gas velocity, stack gas flow rate, and percent isokinetic achieved
- ❑ Summary table for VOST including actual volume sampled, through the sampling train, average meter temperature, and corrected volume

Example Situation: Clark verifies that the summary table includes average data for each run, in addition to the average of all runs conducted for the same method. He also reviews field data sheets completed during the trial burn test and checks the calculations to verify that the data presented in the summary table are consistent.

Example Action: Sections 8.4.1 through 8.4.1.10 of this component contain example sections for each of the stack gas sampling methods that may have been used during the trial burn.

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8.4.3 Reviewing Data Tables for Emission Rates of Constituents of Potential Concern

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The TBR generally contains summary tables that summarize the emission rates of COPCs, which may include various metals, VOCs, and SVOCs (including polychlorinated aromatic hydrocarbons and polychlorinated biphenyls) in addition to PCDDs and PCDFs. The list of COPCs may also include compounds designated as trial burn test POHCs. The number and variety of tables will depend on the number and type of test conditions used by the facility. These summary tables are based on field data sheets, analytical results, and calculations presented in the stack test report. Summary tables presenting the calculations for COPC emission rates (average, minimum, and maximum), standard deviation, and 95th percentile values should be provided.

There is a difference between measured emission rates and the 95th percentile. Emission rates are measurements, where the percentile is a calculation based on the variance in the measurements. As an example, for three measurements with 2 degrees of freedom, the t statistic corresponding to Q as the 95th percentile is 2.920. The 95th percentile is computed as follows:

where: 95^{th} percentile $= \text{Mean} + [(t_{Q,\,0.95})(s)/(n)^{1/2}]$

where:
- $t_{Q,\,0.95}$ = t statistic corresponding to the 95th percentile of a normal distribution
- s = sample standard deviation
- n = sample size

In cases where 3 runs of data are available (n = 3) the calculation simplifies to

$$95^{th}\text{ percentile} = \text{Mean} + (1.686)(s)$$

The number of standard deviations added to the mean is a function of sample size. In some cases, the number of measurements may not be 3. In this case, the appropriate statistic should be used.

Check For: This information may be collected during trial burn or risk burn test conditions. The TBR should clearly indicate the basis for the emission rates

- ❑ Summary tables calculated for COPC emission rates (average, minimum, and maximum), standard deviation, and 95th percentile values for:
  - ❑ Hexavalent chromium
  - ❑ VOCs
  - ❑ SVOCs

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- ❑ PCDD/PCDF
- ❑ Metals
- ❑ PAHs
- ❑ Aldehydes and ketones
- ❑ HC1/Cl2
- ❑ PM

Example Situation: Lois verifies that the summary tables include the minimum, maximum, and average, emission rates for each run, as well as the calculated standard deviation and calculated 95 percentile UCL. She also reviews field data sheets completed during the trial burn test and analytical results and emission calculations contained in the TBR to verify that no errors appear in the summary table emissions data.

Example Action: Sections 8.4.1 through 8.4.1.10 of this component contain example comments for each pollutant that may have been monitored during the trial burn.

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9.0 REVIEWING CHAPTER 6—LABORATORY PROCEDURES

Regulations: 40 CFR Parts 264.13 and 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: It is important to focus the review of the laboratory procedures portion of the TBR on (1) adherence to the approved TBP and approved QAPP sampling and analysis procedures and (2) the presentation of clear and supportable explanations of any deviations from these approved plans. The majority of the effort in evaluating the appropriateness of the sampling and analysis methods is expended during the TBP review period. Therefore, the effort during the TBR review period should be centered around the laboratory's (or laboratories') ability to follow the prescribed procedures. If the laboratory's procedures were somehow flawed or deviations from the prescribed procedures were necessary, then these issues should be presented, explained, and justified to the satisfaction of the permit writer.

This section is broken down into two subsections: Section 9.1, Reviewing the Summary of On-site Analytical Procedures, and Section 9.2, Reviewing the Summary of Off-site Analytical Procedures. These subsections discuss items for review with respect to the particular requirements for off-site and on-site laboratories. Issues for reviewing the QA/QC results from laboratories are discussed in Section 10.0.

For guidance on reviewing the TBP, please see Component 1—How to Review a Trial Burn Plan and the U.S EPA Region 6 Generic TBP, Attachment A to Component 2.

Check For:

- ❑ Reference to the approved TBP and approved QAPP
- ❑ Laboratory QA/QC performance checks
- ❑ Whether all proposed samples were collected
- ❑ Whether all proposed analytical parameters were conducted
- ❑ Any deviations from the approved TBP or QAPP
- ❑ Any problems with sampling, analysis, or QA/QC checks

Example Situation: Clark reviewed the TBR in search of a section discussing on-site sample analysis. He failed to find a section regarding on-site analysis. He knows that many trial burns are designed so that the stack sampling contractor collects all process and waste samples; prepares the chain-of-custody (COC) forms; prepares the composites as necessary; packages the samples for shipment; and ships samples to designated off-site laboratories.

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Example Action: Based on a rereview of the TBP, Clark determined that on-site analyses were planned. He rereviewed the TBR to see if it clearly identified the samples, the laboratories to which they were sent, and the type of analysis at each laboratory.

Upon finding this discussion unclear, Clark requested that the facility clarify where all samples were collected and analyzed for parameters presented in the TBP. Any deviations must be fully explained.

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9.1 REVIEWING THE SUMMARY OF ON-SITE ANALYTICAL PROCEDURES

Regulations: 40 CFR Parts 264.13(b)(2) and 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: On-site analysis conducted during the trial burn should be specifically identified in the TBP. These analyses usually include viscosity, heat value, chloride content, ash content, flashpoint, and density. These analyses may be conducted by the facility because an on-site laboratory is already needed for QC purposes for a manufactured product or to run analyses required by an environmental permit (such as a RCRA permit or an NPDES permit). The TBP may also include procedures for on-site analyses for metals and organic compounds. As long as this approach was approved in the TBP, then the TBR review should focus on the ability of the on-site laboratory to follow the approved procedures and meet the QA/QC objectives. In this case, it is especially important to obtain proof of third-party QA/QC validation.

The stack sampling contractor may also conduct on-site analysis of U.S. EPA Method 0040 samples. These samples—collected in a Tedlar® bag—have a very short holding time (72 hours) and are difficult to ship. Recent experience has shown that an even shorter holding time may be appropriate. The analysis of these samples involves the on-site setup and calibration of a GC system. The TBR reviewer should ensure that all appropriate QA/QC data for the on-site GC are included in the TBR. The TBR reviewer should also check the trial burn test oversight report to ensure consistent reporting of the on-site analytical setup and procedures

Check For:

- ❑ Reference to approved TBP and QAPP
- ❑ Reference to on-site analysis conducted by the facility
- ❑ Reference to on-site analysis conducted by the sampling contractor
- ❑ Discussion of QA/QC checks conducted by the on-site laboratory
- ❑ Discussion of any deviations from approved TBP or QAPP

Example Situation: In reviewing the waste analysis section of the TBR, Clark reads:

"*EPA Identification No. (I.D.) OKD 111222999, Trial Burn Report, Section 5, Waste Analysis.* Section 5.8. Waste Feed Characteristics. Samples of all waste feeds (except lab packs) were collected before the POHC spiking material was added and were analyzed to determine the concentration of the three POHCs and the following general waste characteristics: heat value, ash, organic Cl_2, and viscosity.

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"Various tables in the report present the results."

Example Action: Clark notes that no reference is made to the TBP or methods used to conduct the characterization, and that QA/QC procedures are not discussed. Clark cannot evaluate the performance of the on-site laboratory because no data are presented for comparing known results, and no data are presented for replicate analysis. Clark asks that the facility address these issues in revisions to the TBR.

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9.2 REVIEWING THE SUMMARY OF OFF-SITE ANALYTICAL PROCEDURES

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: When reviewing information on the off-site laboratory procedures, the permit writer should focus on adherence to the approved TBP and QAPP and the laboratory's ability to follow the prescribed procedures. If any deviations were necessary, then the TBR should discuss them. Since the trial burn involves collection of many different types of samples, is it common to use one or more off-site laboratories for analyses. The TBR should identify (1) the samples collected, (2) the laboratory each sample was shipped to, and (3) the analysis conducted at that laboratory. All samples must be properly documented on the completed chain of custody (COC) forms. The samples should be shipped to the off-site laboratory as soon as possible because specific sample holding times apply to all analytical methods.

Check For:

- ❑ Reference to the approved TBP and QAPP
- ❑ Identification of off-site laboratory and analyses conducted
- ❑ Presentation of completed COC forms
- ❑ Discussion of any deviations from approved TBP or QAPP
- ❑ Discussion of QA/QC checks conducted by the off-site laboratory

Example Situation: In reviewing the test results section of the Technical Report, Lois reads as follows:

"*EPA I.D. No. TXD 098642424. Technical Report, Section 5. Test Results*. Section 5. Test Results. This section presents, and briefly discusses, all test results in the following order:

5.1 Waste Feed Characteristics
5.2 U.S. EPA Method 5 Test Data and Particulate Emissions
5.3 DRE for Volatile POHCs
5.4 DRE for Semivolatile POHCs
5.5 PCDD/PCDF Emission Results
5.6 HCl and Cl_2 Emission Rates and HCl Removal Efficiency
5.7 Spray Dry Absorber/Fabric Filter Residue Analysis of Incinerator Ash
5.8 Continuous Emissions Monitoring Data
5.9 Volatile PICs Emission Results
5.10 Semivolatile PICs Emission Results

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"Appendices to the Technical Report include the following:

- Presentations of sampling and analysis procedures
- List of samples collected
- MM5 calculations and PM results
- Contract laboratory results
- Results of various organic compounds
- Continuous emissions data
- Calibration data
- Traceability records

"These appendices provide the detail required to evaluate all analytical procedures used for sample analysis during this trial burn."

Example Action: Lois reviewed all appendices to the technical report to see if the contractor presented a copy of each analytical method used. Lois also confirmed that all analytical methods agreed with those proposed in the TBP. However, Lois commented to the facility that naming or numbering the pages in the appendices would have greatly aided in cross checking information between the Technical Report and the appendices.

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10.0 REVIEWING CHAPTER 7—QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Regulations: 40 CFR Parts 264.13(b)(2)(3) and 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: As with the review of the laboratory procedures, review of the QA/QC results from the trial burn sampling and analysis program should focus on (1) adherence to the approved TBP and approved QAPP sampling and analysis procedures and (2) the presentation of clear and supportable explanations of any deviations from these approved plans. The approved trial burn QAPP should have clearly identified (1) the QA objectives, (2) QA/QC procedures, (3) acceptance criteria for the sampling and analysis methods used during the trial burn, and (4) an outline for the QA/QC information presentation in the TBR.

The TBR should contain, at a minimum, (1) all sampling and analysis field records, (2) all calibration data (both laboratory and field equipment records), (3) all precision and accuracy determinations associated with QA objectives (such as surrogates, spikes, duplicates, and standards reference material), (4) all internal audits, (5) all external audit results (if an external audit was conducted), and (6) the data quality assessment report from the QA coordinator. This information is generally presented as (1) QA/QC data collected during the trial burn (on-site), see Section 10.1, and (2) QA/QC data collected during post-trial burn activities (off-site), see Section 10.2.

For guidance on reviewing the trial burn QAPP, please see Component 2—How to Review a Trial Burn Quality Assurance Project Plan and U.S. EPA Region 6 Generic QAPP, Attachment A to Component 2.

Check For:

- ❑ Reference to the approved QAPP
- ❑ Assessment of data quality
- ❑ Discussion out-of-specification data and QA/QC procedure deviations
- ❑ Listing of equipment calibration frequency
- ❑ Identification of QA/QC objectives, procedures, and results
- ❑ Presentation of data analysis and validation procedures

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Example Situation: Clark noted the following statement while reviewing the QA/QC results portion of the TBR:

"All trial burn data met QA/QC objectives. There were no variances from data quality objectives and all analytical results were within acceptance criteria."

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Example Comments: While the thought of a perfect trial burn data set was overwhelming, Clark realized it was unlikely. Not only was the statement far reaching, it was also unsupported. Clark requested that the facility backup the claim that the data met all objectives with specific references to laboratory results and QA validation comments.

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10.1 REVIEWING THE SUMMARY OF ON-SITE QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Regulations: 40 CFR Part 264.13(b)(2)

Guidance: No specific references are applicable to this section of the manual.

Explanation: On-site QA/QC activities would include any sampling and analysis data quality measures surrounding stack gas samples (see Section 10.1.1) or process samples such as waste feed or residual samples (see Section 10.1.2). The following subsections specifically address these two types of samples.

Check For:

- ❑ Reference to approved TBP and QAPP
- ❑ Documentation of QA/QC activity
- ❑ Discussion of any deviations from approved procedures

Example Section: The approved trial burn QAPP contained a laboratory QA plan. This document defined the systems of QC and quality assessment that compose the QA program for the on-site laboratory.

Major objectives of the on-site laboratory QA program were as follows:

- Use of appropriate methodologies
- Technically competent and well-trained personnel
- State-of-the-art instrumentation and equipment, properly calibrated and maintained
- Adherence to well-defined standard analytical procedures developed for good laboratory and measurement practices
- Analysis and assessment of QC samples, including matrix spike samples, matrix spike duplicate samples, and blanks
- Internal auditing for compliance with standard procedures and assessment of analytical method performance

Example Comments: In reviewing TBRs and supporting documentation, Lois and Clark confirmed that all QA/QC data were presented so that the waste sample results could be validated. In reviewing the QC results, Lois and Clark verified that the discussion included (1) how or where matrix spikes are developed, and (2) whether they are purchased and, if so, the company from which they are purchased.

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10.1.1 Stack Gas Samples

Regulation: 40 CFR Part 60 Appendix A, Method 5
40 CFR Part 266 Appendix IX

Guidance: No specific references are applicable to this section of the manual.

Explanation: Each trial burn requires some form of stack gas sampling. Some trial burns have simpler stack gas sampling requirements, while others, such as a trial burn for a commercial hazardous waste incinerator, require an extensive and complicated stack gas sampling program. When reviewing the QA/QC results for the stack gas sampling field results, it is imperative that the reviewer be familiar with the QA/QC requirements for the various stack gas sampling methods used during the trial burn. Any variations in the stack gas sampling protocol or QA/QC data collection should have been approved in the TBP, or, at the very least, during the pretrial burn meeting. Changes in QA/QC data collection should not come about while the trial burn is in progress. The following "Check For" items detail the field QA/QC data to be reviewed for the more common stack gas sampling procedures.

Check For:

- ❑ U.S. EPA Method 1—Sample and Velocity Traverses
  - ❑ Stack/duct diameter or dimensions
  - ❑ Circular/rectangular
  - ❑ Location of sampling ports
  - ❑ Upstream/downstream disturbance
  - ❑ Number of traverse points
  - ❑ Absence of cyclonic flow
- ❑ U.S. EPA Method 2—Stack Gas Velocity and Flow Rate Determination
  - ❑ Type of pitot tube
  - ❑ Data sheet velocity traverse
  - ❑ Pitot tube coefficient
  - ❑ Pitot tube inspection - documentation and date
  - ❑ Calculation of average stack gas velocity
  - ❑ Calculation of stack gas flow rate
  - ❑ Thermocouple calibration range and date
  - ❑ Barometer calibration date
  - ❑ QC procedures
- ❑ U.S. EPA Method 3—Gas Analysis for CO_2, O_2, Excess Air, and Molecular Weight
  - ❑ Sampling method—single point/multiple point, grab/integrated sampling
  - ❑ Gas analysis method—Orsat or Fyrite analyzer (U.S. EPA

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Method 3) or continuous monitors (U.S. EPA Method 3A)
- ❑ Field data sheet
- ❑ Molecular weight calculation
- ❑ Excess air calculation
- ❑ Leak check for sampling/analyzer
- ❑ QC procedures

❑ U.S. EPA Method 4—Determination of Moisture in Stack Gases

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Constant sampling rate
- ❑ Proper sampling rate
- ❑ Stack properly traversed
- ❑ Train temperature maintained below 68°F
- ❑ Pump/train leak checked
- ❑ Weight of moisture determined

❑ U.S. EPA Method 5/SW-846 Method 0050 or Method 0051—Particulate, HCl/Cl_2

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis

❑ U.S. EPA Modified Method 5/SW-846 Method 0010—Semivolatile Organics

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation for XAD resin
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Sample recovery documentation for blank sample collection
- ❑ GC/flame ionization detector (FID) for unspeciated semivolatile organics

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- ❑ GRAV analysis for non-volatile compounds

❑ U.S. EPA Method 0012/SW-846 Method 0060—Multiple Metals

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Impinger solutions 1, 2, and 3 collected in a prelabeled sample bottle
- ❑ Impinger 4 liquid collected in an amber glass sample bottle
- ❑ Impinger solutions 5 and 6 collected in an amber glass bottle with a Teflon-lined lid
- ❑ Visual inspections conducted

❑ U.S. EPA Method 0013/SW-846 Method 0061—Hexavalent Chromium

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Absorbing liquid continuously recirculated from first impinger through the sample line
- ❑ Probe maintained at a temperature below 200°F throughout sampling
- ❑ Probe ends capped before removing to recovery area
- ❑ pH of impinger 1 above 8.5
- ❑ Nitrogen bubbled through impinger train at 10 liters/minute for 30 minutes
- ❑ Liquid in impingers 1, 2, 3, and 4 weighed and placed in an amber glass sample bottle
- ❑ Contents of container 3 filtered

❑ U.S. EPA Method 0023/SW-846 Method 0023A—PCDD/PCDF Sampling

- ❑ Calibration sheets

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- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Nozzle sealed after being removed from the stack

❑ U.S. EPA Methods 0030 and 0031—Volatile Organic Sampling Train (VOST)

- ❑ Calibration sheets
- ❑ Sample volume
- ❑ Sampling duration
- ❑ Number of trap pairs per test run
- ❑ Leak checks for each run or trap pair
- ❑ Blank traps taken
- ❑ Field data log/documentation for each pair
- ❑ Trap storage and shipment

❑ U.S. EPA Method 0040—Total Volatile Organics

- ❑ Field GC for volatiles

❑ U.S. EPA Method 7E—Determination of Nitrogen Oxides Emissions from Stationary Sources

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds

❑ U.S. EPA Method 10—Determination of Carbon Monoxide Emissions from Stationary Sources

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds
- ❑ Instrument measurement range
- ❑ Performance specification test results

❑ U.S. EPA Method 25A—Determination of Total Gaseous Nonmethane

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Organic Emissions Using a Flame Ionization Analyzer

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds
- ❑ Instrument measurement range
- ❑ Performance specification test results

❑ CO and O_2 CEMS

- ❑ Verification of absence of leakage at CO and O_2 sampling location
- ❑ Calibration gas concentration (zero and high-level)
- ❑ Calibration gas certificate (confirm that CO protocol calibration gases have not expired)
- ❑ Calibration checks before each run and daily
- ❑ Zero and span calibration drift test during trial burn
- ❑ Sampling and analysis conducted every 15 seconds during trial burn
- ❑ Data logged every 60 seconds during trial burn

Example Situation: Clark was reviewing the data sheets for the stack gas sampling at the XYZ Company RCRA trial burn. During the review, Clark noted that for six readings from the U.S. EPA Method 23 data sheet the inlet to the XAD trap was 72°F or higher. The method specifies the inlet temperature must be less than 68°F.

Example Action: Clark requested that XYZ Company review in a detail all U.S. EPA Method 23 sampling results and prepare a report discussing any analytical problems that might be caused by the high inlet temperature. He also requested that XYZ Company compare the U.S. EPA Method 23 results from all three sample runs to determine if the data varied.

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10.1.2 Process Samples

Regulations: 40 CFR Part 266.103
40 CFR Part 270.62

Guidance: No specific references are applicable to this section of the manual.

Explanation: Each trial burn requires some form of process sampling. Some trial burns have simpler process sample requirements, for example, a dedicated boiler with one waste feed stream and one residual stream (the boiler ash). While other trial burns require an extensive and complicated process sampling program, such as for a cement kiln with many influent and effluent streams. As with the stack gas samples, the QA/QC activities for the process samples should follow the procedures prescribed in the approved QAPP. Changes in QA/QC data collection should not come about while the trial burn is in progress. The following "Check For" items detail the field QA/QC data to be reviewed for the process sample sampling procedures.

Check For:

- ❑ Identification of all process samples collected
- ❑ Identification of all QA/QC samples collected
- ❑ Sample frequency
- ❑ Sample volume
- ❑ Sample container and storage conditions
- ❑ Sample method
- ❑ Sample traceability procedures
- ❑ Any special sample preparation requirements

Example Action: In reviewing the TBP (an appendix to the TBR), Clark reads:

"Samples to be collected during each test run will include all waste feeds, lime slurry, spray dryer/filter residual solids, kiln ash, and stack gas. These test runs will be conducted under one incinerator operating condition.

"High-Btu liquid waste will be sampled every 15 minutes by using a trap. Samples will be composited into one sample at the end of the test.

"Aqueous waste will follow the same sampling and compositing as the high-Btu liquid.

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"A grab sample of containerized solid waste will be collected using a scoop for every other solid charge (drum) to the kiln. The sample will be composited and split into three equal samples.

"Bulk solid waste will be sampled by using a scoop to collect several subsamples from the containers. The sample will be mixed and split into three samples."

The TBR stated that the procedures matched those approved in the TBP.

Example Situation: While reviewing the TBR, Clark noted that the facility sampled every other drum. Because he knows that U.S. EPA guidance suggests that each drum fed to the kiln be sampled, he reviews the TBP to see if this procedure was approved. Upon review of the TBP, he realizes that he originally requested that every drum be sampled prior to feeding to the kiln. The facility agreed in a letter to his request, but the actual TBP was never revised. Clark requested that the facility present a discussion on the variability of the drummed waste and its potential impact on the trial burn results.

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10.2 REVIEWING THE SUMMARY OF OFF-SITE QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Regulation: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The TBR should include, at a minimum, off-site QA/QC activities such as, (1) all calibration data (laboratory equipment records), (2) all precision and accuracy determinations associated with QA objectives (such as surrogates, spikes, duplicates, and standards reference material), (3) all internal audits, (4) all external audit results (if an external audit was conducted), and (5) the data quality assessment report from the QA coordinator. Changes in QA/QC data collection should not come about while sample analysis is in progress. The following "Check For" items detail the data to be reviewed for off-site QA/QC activities.

Check For:

- ❑ Sample traceability
- ❑ Holding times
- ❑ Feed stocks, fuel, and APCS residual sample analytical results
- ❑ Stack gas sample analytical results
- ❑ QC assessment
- ❑ QA coordinator report

Example Situation: Clark was reviewing the PCDD/PCDF sample and audit results and noted that the laboratory reported a recovery of 152 percent for one of the PCDF isomers. Clark was concerned that this recovery was above the acceptable limits.

Example Actions: The sampling and analysis method used for identifying the stack gas concentration of PCDDs and PCDFs requires the analysis of an audit sample. The same analyst, analytical reagents, and analytical system must be used for both the stack gas samples and the U.S. EPA audit sample.

The accepted criterion for accuracy is 50 to 150 percent recovery of this audit or spiked surrogate. The criterion for precision is less than 40 percent relative percent difference for the audit or surrogate spikes. If more than three determinations are made the precision criterion drops to less than 35 percent relative percent difference.

Because the audit sample indicates that the results may be biased high, Clark determined that the calculated emission rates were probably higher than actual, and therefore more conservative. He asked that the facility qualify the data and

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noted that the issue may result in a higher than actual calculated risk during the HHRA process. Clark requested that the facility have the laboratory evaluate the high recovery for one isomer on accuracy. He also requested that any calculation changes from stack gas samples be documented and explained in detail.

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11.0 REVIEWING CHAPTER 8—TRIAL BURN RESULTS SUMMARY AND PROPOSED PERMIT LIMITS

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section of the report should summarize trial burn performance results and compare the results to TBP performance objectives. It should also summarize proposed permit limits and the rationale for proposing those limits.

Depending on the design and complexity of the trial burn test (that is, the number and variation of waste feed combinations and combustion unit and APCS operating parameters), the proposed permit limits may be derived from one or more test conditions. The TBR review team will need to review the TBP to identify how each permit limit was to be determined.

However, while certain permit limits may be derived from only one test condition (for example, APCS inlet temperature may be derived from the high temperature test condition used to demonstrate compliance with the metals standards), this should not preclude a facility from presenting all data from all test conditions (in this case, APCS inlet temperature should be monitored and reported for all runs of all conditions. This will allow the TBR test review team—and ultimately the permit writer—to ensure that the proposed permit conditions are appropriate and protective of human health and the environment.

Additional guidance regarding the development of permit conditions is included in Component 7—How to Prepare Permit Conditions.

Check For: This chapter should include subsections on the following topics:

- ❑ Destruction and removal efficiencies (see Section 11.1)
- ❑ CEMS results (see Section 11.2)
- ❑ Stack gas emission rate results (see Section 11.3)
- ❑ Proposed process limits (see Section 11.4)
- ❑ Proposed waste feed limits (see Section 11.5)
- ❑ Proposed automatic waste feed cutoff limits (see Section 11.6)
- ❑ Proposed data for use in the risk assessment (see Section 11.7)

While reviewing these sections of the TBR, the review team should check for the following:

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- ❑ Emission rate results summary for each run
  - ❑ DRE for each POHC (DRE test condition)
  - ❑ PCDD/PCDF emission rates (risk burn test condition)
  - ❑ Metals emissions rates (high temperature and risk burn test conditions)
  - ❑ Hexavalent chromium emission rate (high temperature and risk burn test conditions)
  - ❑ HCl/Cl_2 emission rates (all test conditions)
  - ❑ CO concentration levels in flue gas (all test conditions)
  - ❑ VOC and SVOC emission rates (DRE and risk burn test conditions)
  - ❑ Particle size distribution (PSD) (risk burn test condition)
  - ❑ TO emission rates for volatile, semivolatile, and GRAV fractions (risk burn test condition)

- ❑ Summary of the key trial burn operating conditions (these data should include the following values for each run: minimum, maximum, average, standard deviations, average HRAs, minimum HRAs, and maximum HRAs)
  - ❑ Liquid waste feed rate
  - ❑ Combustion chamber temperature
  - ❑ Baghouse (or APCS) inlet temperature
  - ❑ Stack gas O_2 concentration
  - ❑ Ash feed rate
  - ❑ Chloride feed rate
  - ❑ Metals feed rate
  - ❑ Baghouse differential pressure
  - ❑ Combustion gas velocity
  - ❑ Auxilliary fuel feed rate
  - ❑ Other APCS key parameters

- ❑ Proposed permit limits
  - ❑ Maximum waste feed rate
  - ❑ Minimum and maximum combustion gas temperature
  - ❑ Maximum combustion gas flow rate
  - ❑ Minimum and maximum production rate
  - ❑ Minimum stack gas O_2 concentration
  - ❑ Maximum baghouse inlet temperature
  - ❑ Minimum baghouse differential pressure
  - ❑ Maximum ash feed rate
  - ❑ Maximum chloride rate
  - ❑ Maximum BIF metals rate
  - ❑ Auxilliary fuel feed rates
  - ❑ Total pumpable waste feed rate

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- ❑ APCS parameters

Sections 11.1 through 11.7 of this component provide more detailed information for the parameters included under this "Check For" section.

Example Situation: Clark notes that the TBR for the boiler includes suggested permit limits for minimum and maximum boiler furnace (combustion gas) temperature. While steam production rates were monitored during the trial burn test (based on Clark's review of the oversight report), no raw data or proposed permit limits are presented in the TBR. However, a stated objective of the TBP was to establish the operating envelope in terms of steam production rate during the trial burn.

Example Action: Clark asks that the facility revise this section of the TBR and related tables to include proposed minimum and maximum steam production rates.

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11.1 REVIEWING DESTRUCTION AND REMOVAL EFFICIENCIES

Regulations: 40 CFR Part 264.343.
40 CFR Part 266.104

Guidance: U.S. EPA 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 3.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations. EPA-530-R-92-011. Chapters 2, 5, and 10.

Explanation: A DRE of 99.99 percent must be demonstrated during the trial burn test for each POHC. DRE is calculated as the difference between the mass emission rate and mass feed rate of each POHC. The DRE value of 99.99 percent must be attained without rounding (that is, 99.987 cannot be rounded up to 99.99).

Check For:

- ❑ DRE of at least 99.99 percent for each POHC (during each run of the DRE test condition) identified in the trial burn
- ❑ DRE calculations, including POHC feed rate and POHC stack gas emissions rate

Example Situation: On reviewing the TBR, Lois uses the following equation to verify the DRE for each POHC.

$$DRE = \left(1 - \frac{W_{out}}{W_{in}} \right) x \ 100$$

where

W_{out} = Mass rate of the same POHC in stack gas (if POHC is present in the incinerator ash or residue, the mass rate of POHC in the ash and residue should be added to the stack gas POHC emission rate)

W_{in} = Mass feed rate of individual POHC in the hazardous waste fired to the BIF unit

Example Comments: The mass of each POHC entering the BIF can be calculated by using waste feed analytical results and waste feed mass flow rate to the BIF. The mass of each POHC in the flue gas is calculated using the average stack gas flow rate measured by an isokinetic sampling train and stack sample analytical results. For compounds that are sampled using an isokinetic sampling train, the average standard stack gas flow rate is used to calculate DRE. Exhibit 11.1-1, see page 6-126, shows DRE calculations for benzene. The following shows step-by-step procedures for calculating the DRE based on the results presented in Exhibit

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11.1-1, see page 6-126.

Benzene feed rate (lb/hr) = Average waste mass feed rate (lb/hr) x benzene concentration in percent/100

= 2,721 x 21.5/100

= 585 lb/hr

Total benzene collected = Sum of all tube pairs as reported by laboratory

= 606 + 478 + 481

= 1,565 nanograms (ng)

Stack gas sample volume (L) = 60.8 liter (from data sheet)

This is the volume of gas that passed through the sampling train.

Stack gas concentration of benzene in grams per day standard cubic meter (g/dscm).

$$= \frac{1{,}565\ ng}{10^9 \frac{ng}{g}} \quad x \quad \frac{1}{60.8\ L} \quad x \quad \frac{dscm}{1x10^{-3}\ L}$$

$$= \quad 2.57\ E{-}05 \quad \frac{g}{dscm}$$

Average stack gas flow rate calculated
using Methods 1 through 4 = 10,310 dscf

Benzene emission rate (g/sec)

$$= \quad 2.57\ E{-}05\ \frac{g}{dscm}\ x\ 10{,}310\ \frac{dscf}{\min}\ x\ 2.832x10^{-2}\ \frac{dscm}{dscf}\ x\ \frac{\min}{60\ \sec}$$

= 1.25E-04 g/sec

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Bezene emission rate (lb/hr)

$$= 1.25\ E{-}04\ \frac{g}{\text{sec}}\ x\ \frac{lbs}{453.54g}\ x\ 3600\ \frac{\text{sec}}{hr}$$

= 0.000992 lb/hr

$$Benzene\ DRE\ percent\ =\ (1\ -\ \frac{Benzene\ out}{Benzene\ in})\ x\ 100$$

$$=\ (1\ -\ \frac{0.001}{585})\ lb/hr\ x\ 100$$

= 99.99983%

Check and verify DRE for each POHC using the above procedures

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Table 5–1. Benzene Destruction and Removal Efficiency
Kalama Chemical Trial Burn – U–3 Boiler

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Average Runs 1–3	Average Runs 4–6
Average Waste Mass Feed Rate (lb/hr)	2,721	2,723	2,717	1,640	1,648	1,632	2,721	1,640
Benzene Concentration (%)	21.5	20	19	70.5	78	74	20	74
Benzene Feed Rate (lb/hr)	585	545	516	1,156	1,285	1,208	549	1,216
Tube Pair No. 1 (ng)	606	1,833	N/A	881	N/A	N/A	813	294
Tube Pair No. 2 (ng)	478	1,940	455	1,874	983	1,137	958	1,331
Tube Pair No. 3 (ng)	481	2,200	787	1,882	769	1,597	1,156	1,416
Tube Pair No. 4 (ng)	N/A	N/A	1,320	N/A	822	1,282	440	701
Total Benzene Collected (ng)	1,565	5,973	2,562	4,637	2,574	4,016	3,367	3,742
Stack Gas Sample Volume (L)	60.8	60.3	61.3	61.3	61.1	60.4	60.8	60.9
Stack Concentration of Benzene (g/dscm)	2.57E–05	9.91E–05	4.18E–05	7.56E–05	4.21E–05	6.65E–05	5.55E–05	6.14E–05
Average Stack Flow Rate (dscfm)	10,310	10,150	10,381	9,261	8,496	8,805	10,280	8,854
Benzene Emission Rate (lb/hr)	9.94E–04	3.77E–03	1.63E–03	2.62E–03	1.34E–03	2.19E–03	2.13E–03	2.05E–03
Benzene Emission Rate (g/s)	1.25E–04	4.75E–04	2.05E–04	3.31E–04	1.69E–04	2.76E–04	2.68E–04	2.59E–04
Benzene DRE (%)	99.99983	99.99931	99.99969	99.99977	99.99990	99.99982	99.99961	99.99983

L – liters (dry, 68°F and 29.92 in Hg)
ng/dscm – nanograms per dry standard cubic meter
dscfm – dry standard cubic feet per minute
g/s – grams per second
DRE – destruction and removal efficiency
N/A – not available

$$\left(1 - \frac{9.94E\text{-}04}{585}\right) \times 100 = 99.99983$$

$$\left\{1.25E\text{-}04 \frac{g}{s} \times \frac{lbs}{453.59 g} \times \frac{3600\ sec}{hr} = \frac{lbs}{hr}\right\}$$

$$\left\{\frac{1{,}565\ ng}{10^9 \frac{ng}{g}} \times \frac{1}{60.8\ L} \times \frac{dscm}{1 \times 10^{-3} L} = \frac{g}{dscm}\right\}$$

$$\left\{2.57E\text{-}05 \frac{g}{dscm} \times 10{,}310 \frac{dscf}{min} \times \frac{2.832 \times 10^{-2}\ dscm}{dscf} \times \frac{min}{60\ sec}\right\}$$

11.2 REVIEWING CONTINUOUS EMISSION MONITORING SYSTEM RESULTS

Regulation: 40 CFR Part 266.104

Guidance: U.S. EPA 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapters 2 and 10.

Explanation: Stack gas CO concentrations from a BIF burning hazardous waste should not exceed 100 ppmv, corrected to 7 percent O_2, on an HRA basis. For some BIFs the 100 ppmv value may be exceeded, provided that the total hydrocarbon (THC) level does not exceed 20 ppmv. The CEMS strip charts should be closely reviewed to assess compliance with the 100 ppmv limit (or other limit as appropriate)

Check For:

- ❑ Whether CO concentration, during testing (for each run, all test conditions), corrected to 7 percent O_2, is below 100 ppmv

Example Situation: Clark notes that the TBR summary table shows that the average CO concentration in flue gas was 95 ppmv. A review of the field data logsheet and strip chart also shows that the average CO concentration was 95 ppmv.

Example Action: The CO concentration from a BIF unit should not exceed 100 ppmv, corrected to 7 percent O_2 (unless the facility proposes to monitor THC). Results for CO should also be presented after correction to 7 percent O_2. Clark asks that the facility clarify whether CO concentration was corrected to 7 percent O_2 and, if so, if the CO concentration was measured before or after the correction. Section 7.5.1 of this component contains the formula for correcting measured CO concentration to 7 percent O_2.

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11.3 REVIEWING STACK GAS EMISSION RATE RESULTS

Regulations: 40 CFR Part 266.103

Guidance: U.S. EPA 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 3.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapters 5 and 10.

Explanation: This section should summarize the stack gas emission rate for PM, particle size distribution (PSD), HCl, and Cl_2, metals, POHCs, PICs, organics, and PCDD/PCDF for each run. Stack gas emission rate values should be calculated for actual, dry standard during which this data is collected, and 7 percent O_2 conditions.

Check For: This chapter of the TBR should include subsections regarding the following topics:

- ❑ PM and PSD results for each run (see Section 11.3.1)
- ❑ HCl and Cl_2 emission rate results for each run (see Section 11.3.2)
- ❑ Metals emission rate results for each run (see Section 11.3.3)
- ❑ POHC emission rate results for each run (see Section 11.3.4)
- ❑ PIC emission rate results for each run (see Section 11.3.5)
- ❑ TO emission rate results for each run (see Section 11.3.6)
- ❑ PCDD/PCDF emission rate results for each run (see Section 11.3.7)

This section discusses how to review the emission rate results for each of these compounds. Sections 11.3.1 through 11.3.7 of this component include example sections for each of the emission parameters

Example Section: A summary table in the TBR reviewed by Lois shows PIC emission rates as 0 lb/hr.

Example Comments: Although PICs were below the detection limits, PIC emission rates should be calculated using the detection limit and the emission rate shown as a value less than "<" the detection limit.

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11.3.1 Reviewing Particulate Matter Emission Rate Results

Regulations: 40 CFR Part 266.105

Guidance: No specific references are applicable to this section of the manual.

Explanation: BIFs burning hazardous waste may not emit PM in excess of 180 micrograms per dry standard cubic meter (μg/dscm) or 0.08 gr/dscf after correction to a stack gas concentration of 7 percent O_2. This data is typically collected during all runs and all test conditions. The PM emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95th percentile.

The U.S. EPA 1992 TID guidance for BIFs recommends that soot blowing occur during one run of each trial burn test. Particulate emissions measured during these soot blowing runs should be corrected as follows.

$$E = [(E_{sbr}-E_{nosb}) \times ((AS+BS)/AR) \times (C_n/C_t)] + E_{nosb}$$

Where

E = corrected emission rate
E_{sbr} = average emissions during test run with soot blowing corrected to 7% oxygen
E_{nosb} = average emissions during test runs without soot blowing corrected to 7% oxygen
A = hours of soot blowing during test run with soot blowing
B = hours without soot blowing during test run with soot blowing
S = normal number of hours of soot blowing per 24 hours
R = normal hours of operation per 24 hours
C_n = normal number of hours between cleaning cycles
C_t = number of hours between cleaning cycles during test

In situations involving no soot blowing, the particulate emissions measured during all valid test runs must be less than the emissions standard of 0.08 gr/dscf. In situations involving soot blowing, the measured particulate emissions during the soot blowing run may exceed the emissions standard provided the corrected emission rate is less than the emission standard.

Note: Every reviewer should also be aware and verify compliance with other applicable PM limits from Clean Air Act (CAA) permits and regulations, since more stringent PM limits are often applicable.

Check For:

- ❑ Whether emission rate is less than 180 μg/dscm (0.08 gr/dscf)

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- ❑ PM emission calculations
- ❑ Whether isokinetic sampling results are acceptable (within 90 to 110 percent)
- ❑ Appropriate correction for soot blowing

Example Situation: Exhibit 11.3.1-1, see page 6-132—*Worksheet 8 Data Reduction for U.S. EPA Method 5 Sampling Train* lists data collected during testing and shows step-by-step procedures for calculating the particulate emission rate in lb/hr.

In reviewing the TBR, Clark verifies that a field data log sheet average entry is shown for each parameter being used in Worksheet 8 PM calculations. He also verifies all calculations for accuracy.

The stack test report included in the TBR shows PM emissions rates of 3.21, 3.23, and 3.22 lb/hr for Runs 1, 2, and 3, whereas the TBR summary table shows PM emission rates of 3.41, 3.43 and 3.42 lb/hr.

The stack test report for a similar on-site unit shows that PM emissions during the three runs of the DRE test were as follows:

Run 1, 0.070 gr/dscf
Run 2, 0.060 gr/dscf
Run 3, 0.090 gr/dscf

At first glance, it appears that the emissions standards for PM was exceeded during Run 3 and the trial burn was thus a failure. Reading further into the report, however, Clark notes that soot blowing occurred during Run 3. Clark reviews the test documentation in more detail and determines the following:

Duration of Run 3 = 3 hours
Length of soot blowing event during Run 3 (A) = 1 hour
Normal hours of soot blowing per 24 hours (S) = 3
Normal hours of operation per day (R) = 24
Normal hours between cleaning cycles = 8
Number of hours between cleaning cycles during test = 8

Example Action: Clark's review of calculations confirms that the emissions indicated in the stack test report (3.21, 3.23, and 3.22) are correct. He asks that the facility revise the TBR summary table to reflect the correct values.

Clark applies the soot blowing correction factor as follows:

$$E = [(0.09 - ((0.07+0.06)/2)) \times ((1)(3) + (3-1)(3))/(1)(24) \times (8/8)] + ((0.07+0.06)/2))$$

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= 0.074 gr/dscf

Clark's calculation shows that the corrected emission rate was less than the standard. Clark, therefore, determined that the trial burn was a success with regard to PM emissions.

Notes: _____

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EXHIBIT 11.3.1-1

REVIEWING PARTICULATE MATTER EMISSION RATE RESULTS

WORKSHEET 8

DATA REDUCTION FOR METHOD 5 SAMPLING TRAINS

The following delineates the formulas needed to complete this worksheet. If the testing staff normally reduce the sampling data by means of a computer, these calculations would not need to be used. Each parameter is to be recorded for each sampling train operated during each run.

Line 2: Final meter volume corrected by subtracting non-sample volumes as during port change leak checks.

Line 4: Refer to the Method 5 procedures for leak rates which are greater than 0.02 cubic feet per minute.

Line 5: (Line 2 - Line 1) x Line 3

Line 6: Average of all meter temperatures recorded during sampling

Line 9: Line 7 + (Line 8 + 13.6)

Line 10: Average of all ΔH recorded during sampling

Line 11: Average of all the square roots of the ΔP recorded during sampling

Line 12: $(\text{Line } 11)^2$

Line 13: $(\text{Line } 5) \times 17.64 \times \dfrac{\text{Line } 7 + (\text{Line } 10 + 13.6)}{\text{Line } 6 + 460}$

Line 14 & Line 15: Orsat analysis results for stack gas

Line 17:

If stack gas is not saturated:

$$\frac{0.047 \times \text{Line } 16}{(0.047 \times \text{Line } 16) + \text{Line } 13}$$

If stack gas is water saturated:

$$\frac{\text{Vapor pressure of water at stack temp.}}{\text{Line } 9}$$

Line 18: Average of all stack temperatures recorded during sampling

Line 19: (0.32 x Line 14) + (0.44 x Line 15) + (0.28 x (100 - Line 14 - Line 15))

Line 20: Line 19 x (1-Line 17) + (18 x Line 17)

Line 26: Circular, square, rectangular ... etc.

Line 27:

For Circular: $(\text{axis})^2 \times \pi \div 576$

For Square: $(\text{axis})^2 \div 144$

For Rectangle: (axis #1) x (axis #2) ÷ 144

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EXHIBIT 11.3.1-1 (Continued)

REVIEWING PARTICULAR MATTER EMISSION RATE RESULTS

Line 28: $5129.4 \times \text{Line 21} \times \text{Line 11} \times \sqrt{\frac{\text{Line 18} + 460}{\text{Line 20} \times \text{Line 9}}}$

Line 29: $0.0945 \times \frac{(\text{Line 18} + 460) \times \text{Line 13}}{\text{Line 9} \times (\text{Line 28} + 60) \times A_s \quad \text{Line 22} \times (1 - \text{Line 27})}$

Where $A_s = (\text{Line 23})2 \times \pi + 576$

Line 30: Line 28 x Line 27

Line 31: $\frac{\text{Line 30} \times 17.64 \times \text{Line 19}}{\text{Line 18} + 460}$

Line 32: Line 31 x (1 - Line 17)

Line 34: 15.43 x (Line 33 + Line 13)

Line 35: (14 x Line 34) + (21 - Line 14)

Line 36: (Line 34 x 12) + Line 15

Line 37: $\frac{272.15 \times \text{Line 33} \times \text{Line 9}}{(\text{Line 13} + (0.047 \times \text{Line 16})) \times (\text{Line 18} + 460)}$

Line 38: $\frac{\text{Line 34} \times \text{Line 32} \times 60}{7{,}000}$

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EXHIBIT 11.3.1-1 (continued)

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REVIEWING PARTICULATE MATTER EMISSION RATE RESULTS

MODE: _____ TEST CONDITION: _____ RUN NO.: _____ DATE: _____

WORKSHEET 8: DATA REDUCTION FOR U.S. EPA Method 5 SAMPLING TRAIN				
Line No.	Parameter	Sampling Train		
		Particulate	Multiple Metals	
1	Initial Meter Volume, cubic feet			
2	Final Meter Volume, cubic feet			
3	Meter Factor			
4	Multiple Leak Checks			
5	Net Meter Volume, cubic feet			
6	Average Meter Temperature, F			
7	Barometric Pressure, inches mercury (Hg)			
8	Static Pressure, inches water			
9	Stack Pressure, inches Hg			
10	Average $\triangle$H, inches water			
11	Average Square Root of $\triangle$P, inches water			
12	Average $\triangle$P, inches water			
13	Gas Volume, dry standard cubic feet			
14	Percent Oxygen			
15	Percent Carbon Dioxide			
16	Moisture Collected, milliliters			
17	Fraction Water			
18	Average Stack Temperature, °F			
19	Dry Molecular Weight			
20	Wet Molecular Weight			
21	Pitot Coefficient			
22	Sampling Time, minutes			
23	Nozzle Diameter, inches			
24	Stack Axis No. 1, inches			
25	Stack Axis No. 2, inches			
26	Stack Geometry			
27	Stack Area, square feet			
28	Stack Velocity, actual feet/min			

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EXHIBIT 11.3.1-1 (Continued)
REVIEWING PARTICULATE MATTER EMISSION RATE RESULTS

WORKSHEET 8: DATA REDUCTION FOR U.S. EPA Method 5 SAMPLING TRAIN (Continued)				
Line No.	Parameter	Sampling Train		
		Particulate	Multiple Metals	
29	% Isokinetic			
30	Flow Rate, actual cubic feet/min			
31	Flow Rate, standard cubic feet/min			
32	Flow Rate, dry standard cubic feet/min			
33	Particulate Weight, grams			
34	Particulate Loading, grains/dry standard cubic feet			
35	Corrected to 7% Oxygen			
36	Corrected to 12% Carbon Dioxide			
37	Particulate Loading, grains/cubic feet			
38	Emission Rate, lb/hr			

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11.3.2 Reviewing Hydrogen Chloride and Chlorine Gas Emission Rate Results

Regulation: 40 CFR Part 266.107

Guidance: No specific references are applicable to this section of the manual.

Explanation: BIF regulations (40 CFR Part 266.107) require that the facility meet permit limits for HCl and Cl_2 (Tier I, adjusted Tier I, Tier II, or Tier III). This data is typically collected during all runs and all test conditions. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions. The HCl and Cl_2 emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the viability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95th percentile.

Check For:

- ❑ Trial burn HCl and Cl_2 emission rates (use field data and laboratory results to see whether TBP objectives were met)
- ❑ HCl and Cl_2 emission rate calculations

Example Situation: Exhibit 11.3.2-1, see page 6-137—Worksheet 9—provides step-by-step procedures for calculating HCl and Cl_2 emission rates.

In reviewing the TBR, Lois verifies that field and data logsheet and Worksheet 9 entries are made for each parameter being used to calculate the Cl_2 emission rate. She also verifies all calculations for accuracy.

For Run No. 1, the field logsheet data shows that the dry meter gas volume was 31.51 ft^3, whereas Worksheet 9 used for the Cl_2 emission rate calculation shows a stack gas sample volume of 39.40 dscf.

Example Action Lois verifies that 31.51 ft^3 of dry meter gas volume was collected during Run No. 1, as shown on the field data logsheet. Lois uses this value to verify the calculations.

Notes: _____

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EXHIBIT 11.3.2-1
REVIEWING CHLORINE EMISSION RESULTS

WORKSHEET 9

CHLORINE EMISSION RESULTS

HCl and Cl_2 emissions must be calculated for each run at each test condition. Laboratory analysis for chlorine concentrations are obtained for both the condensate and the caustic samples recovered from the sampling train. The impinger volume is obtained from field laboratory recovery data sheets. The quantity of chlorine found in each impinger solution shall be calculated by multiplying the chlorine concentration times the impinger volume.

The gas sample volume should be obtained from Worksheet 8, Line 13, for each run. The chlorine concentration is obtained by dividing the quantity found by the stack gas sample volume and dividing that result by 1,000. The chlorine emission result, in g/sec, is calculated by multiplying the chlorine emission concentration times the stack flow (obtained from Worksheet 8, Line 32). Finally, the HCl emission rate is calculated by multiplying the chlorine emission as measured in the condensate by 1.03. Cl_2 emission rate is equal to the chlorine emission as measured in the caustic solutions.

Summary:

Column c = Column a x Column b

Column e = (Column c + Column d) + 1,000

Column g = Column e x Column f + 60

Column h, Line 1 = Column g x 1.03

Column i, Line 2 = Column g

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EXHIBIT 11.3.2-1 (continued)
REVIEWING CHLORINE EMISSION RESULTS

MODE: _____ TEST CONDITION: _____

WORKSHEET 9. CHLORINE EMISSION RESULTS

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(I)	
Run # and Date	Impinger Solution	Chloride Conc. (mg/L)	Impinger Volume (L)	Quantity Found (mg)	Stack Gas Sample Volume (dscf)	Cl Conc. (g/dscf)	Stack Flow (dscf/min)	Cl Emission (g/sec)	HCl Emission (g/sec)	Cl_2 Emission (g/sec)	Line No.
	Condensate										1
	Caustic										2
	Condensate										1
	Caustic										2
	Condensate										1
	Caustic										2

11.3.3 Reviewing Metal Emission Rate Results

Regulations: 40 CFR Part 266.106

Guidance: No specific references are applicable to this section of the manual.

Explanation: BIF regulations (40 CFR Part 266.106) require that the facility meet permit limits for metal emissions (Tier I, adjusted Tier I, Tier II, or Tier III). This data is typically collected during the high temperature and risk burn test conditions. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions. The metals emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95th percentile.

Check For:

- ❑ Trial burn results for metal emissions to see whether TBP objectives were met
- ❑ Metal emissions calculations

Example Section: Exhibit 11.3.3-1, see page 6-140—Worksheet 10—provides step-by-step procedures for calculating metal emissions using field data and laboratory analysis results.

Example Comments: Determining metal emissions during the trial burn is not required if the facility meets Tier I or adjusted Tier I emission rate screening limits.

Notes: _____

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EXHIBIT 11.3.3-1

REVIEWING METAL EMISSION RATE RESULTS

Worksheet 10

Analysis Results for Metals Sampling Train

The five portions of the MM5-M metals sampling train to be analyzed for metals are:

1. Acetone rinse
2. Nitric rinse
3. Filter
4. Condensate and nitric acid/peroxide impingers (back half)
5. Potassium permanganate/sulfuric acid impinger (mercury [Hg] only).

Worksheet 10 should be completed with results from laboratory analysis. Values below detection limits are assumed to be zero, so that the totals represent amounts actually found, except when all component analyses for a run are below detection limits. A "less than" value should then be reported.

The totals of each metal for each run are calculated by adding the five portions of the MM5-M sampling train. The concentration (Line 7) is calculated by dividing this total by the sample volume obtained from Worksheet 8, Line 13. Finally, the emissions value is calculated by multiplying the concentration by the stack flow rate, obtained from Worksheet 8, Line 32, and dividing the product by 60×10^6.

Summary:

Line 6 = Line 1 + Line 2 + Line 3 + Line 4 + Line 5 (Hg only)

Line 7 = Line 6 ÷ Worksheet 8, Line 13

Line 8 = Line 7 x Worksheet 8, Line 32 ÷ (60×10^6)

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EXHIBIT 11.3.3-1 (Continued)

REVIEWING METAL EMISSION RATE RESULTS

MODE: _____ Test Conditions: _____

WORKSHEET 10, ANALYSIS RESULTS FOR METALS SAMPLING TRAIN

Metal:	Ag	As	Ba	Be	Cd	Cr	Hg	Pb	Sb	T1	Line No.
Run No. /Date											
Acetone Rinse, μg											1
Nitric Rinse, μg											2
Filter, μg											3
Nitric Acid Impingers, μg											4
$KMnO_4$ Impingers, μg	NA	NA	NA	NA	NA	NA		NA	NA	NA	5
Total, μg											6
Sample volume, dscf											7
Concentration μg/dscf											8
Stack gas flow rate, dscf/s											9
Emissions, g/sec											10
Run No. /Date											
Acetone Rinse, μg											1
Nitric Rinse, μg											2
Filter, μg											3
Nitric Acid Impingers, μg											4
$KMnO_4$ Impingers, μg	NA	NA	NA	NA	NA	NA		NA	NA	NA	5
Total, μg											6
Concentration, μg/dscf											8
Stack gas flow rate, dscf/s											9
Emissions, g/sec											10

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EXHIBIT 11.3.3-1 (Continued)

REVIEWING METAL EMISSION RATE RESULTS

MODE: _____ Test Conditions: _____

WORKSHEET 10, ANALYSIS RESULTS FOR METALS SAMPLING TRAIN												
Metal:		Ag	As	Ba	Be	Cd	Cr	Hg	Pb	Sb	T1	Line No.
Run No. /Date												
	Acetone Rinse, μg											1
	Nitric Rinse, μg											2
	Filter, μg											3
	Nitric Acid Impingers, μg											4
	$KMnO_4$ Impingers, μg	NA	NA	NA	NA	NA	NA		NA	NA	NA	5
	Total, μg											6
	Sample volume, dscf											8
	Concentrations μg/dscf											9
	Stack g-as flow rate, dscf/s											10
	Stack g-as flow rate, dscf/s											10
	Emissions, g/sec											

11.3.4 Reviewing POHC Emission Rate Results

Regulations: 40 CFR Part 266.104

Guidance: No specific references are applicable to this section of the manual.

Explanation: BIF regulations (40 CFR Part 266.104) requires that the DRE be demonstrated during the trial burn for each POHC designated in the permit for each waste feed. This data is collected at the DRE test condition. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions. The POHC emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95^{th} percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95^{th} percentile.

Check For:

- ❑ Trial burn results of POHC emissions to see whether TBP objectives are met
- ❑ POHC stack gas emission calculations (check field data logsheets and analytical report)

Section 11.1 of this component presents POHC (benzene) emission rate sample calculations. To calculate POHC in ash and residue, multiply the POHC concentration in the ash and residue by the ash and residue generation rate, respectively.

Example Situation: In reviewing the TBR, Clark notes that the analytical report shows a benzene concentration of 5 nanograms, per sampling volume. The POHC emission rate results for benzene, however, is presented as <0.003 lb/hr.

Example Action: Clark asks that the facility revise the summary table to show the actual mass rate for benzene.

Notes: _____

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11.3.5 Reviewing PIC Emission Rate Results

Regulations: Not applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: If the gas temperature in the combustion zone of the combustion unit drops below the minimum, gas leaving the combustion unit may still contain undestroyed POHCs and hazardous PICs. Generally, the gas temperature in the combustion zone is maintained to minimize PIC formation. PIC testing is conducted for VOCs, SVOCs, and PCDD/PCDFs using U.S. EPA Methods 0030, 0031, 0010, and 23 (or 0023A). The presence of PICs in stack gas should be checked by reviewing the results for those sampling trains. This data should be collected at the risk burn test condition. Additionally, VOC and SVOC PIC and Cl_2 data may be available from the DRE test condtition, depending on the nature of the POHCs used to demonstrate DRE.

The emission rate of each PIC should be presented as the maximum of the three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95th percentile.

VOC emission rates should be calculated using the average stack gas flow rate measured by any isokinetic sampling trains operating during the same sampling period. If no isokinetic sampling trains were operated while the VOST sample was collected (for example, sequential sampling), the reviewer should carefully review combustion unit operating conditions, select a test run where operating conditions are comparable to those during the VOST run, and use the average stack gas flow rate from the comparable test run to reduce the VOST field sampling data. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions.

Check For:

- ❑ VOC PICs emission rate based on VOST results (U.S. EPA Methods 0030 and 0031)
- ❑ SVOC PICs emission rate based on SVOST results (sampling U.S. EPA Method 0010, analytical U.S. EPA Method 8270)

Example Situation: In reviewing the TBR, Clark notes that compounds D, E, and F were not detected by the laboratory and that the average mass emission rate for these compounds was reported as 0 lb/hr. See Section 11.3.6 of this component for example comments.

Example Action: If a compound was not detected by an analytical method, the detection limit value should be used for calculations. Clark asks that the facility insert a "<" (less than) symbol in front of the value when reporting results in the TBR. See Section 11.3.6 of this component for example comments.

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Notes:

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11.3.6 Reviewing Total Organic Emission Rate Results

Regulations: Not applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: In order to determine the total organic emission rate, three fractions of organic compounds are added together: the volatile fraction of compounds with a boiling point less than 100°C; semivolatile compounds with a boiling point range of 100°C to 300°C; and nonvolatile compounds with a boiling point greater than 300°C. This data is collected at the risk burn test condition. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions. The TO emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculating the 95th percentile.

Check For:

- ❑ Volatile organics emission rate of compounds determined using U.S. EPA Method 0040 (SW-846)
- ❑ Semiovolatile organics emission rate of compounds determined using U.S. EPA Method 0010 (SW-846)
- ❑ Nonvolatile organics emission rate of compounds determined using U.S. EPA Method 0010 (SW-846)

Example Situation: The following method can be used as a guide to verify the total organics emission rate calculation.

Review of the TBR indicated the following:

Sampling Method Used/Compounds	Total Weight of Organics as Reported by the Laboratory (nanograms)	Total Sample Volume of Stack Gas through the Sampling Train (liters)
0040/Volatile Organics	1,565	60.8
0010/Semivolatile Organics	3,130	91.2
0010/Nonvolatile Organics	1,043.3	91.2
Stack gas flow rate calculated using methods 1 through 4 = 10,310 dscfm		

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Stack gas concentration of all volatiles (g/dscm)

$$= \frac{1{,}565\ ng}{10^9\ \frac{ng}{g}} \times \frac{1}{60.8L} \times \frac{1x10^{-3}L}{dscm} = 2.57\ E{-}05\ \frac{g}{dscm}$$

Stack gas concentration of all semivolatiles (g/dscm)

$$= \frac{3{,}130\ ng}{10^9\ \frac{ng}{g}} \times \frac{1}{91.2\ L} \times \frac{1x10^{-3}\ L}{dscm} = 3.43\ E{-}05\ \frac{g}{dscm}$$

Stack gas concentration of all nonvolatiles (g/dscm)

$$= \frac{1{,}043.3\ ng}{10^9\ \frac{ng}{g}} \times \frac{1}{91.2\ L} \times \frac{1x10^{-3}\ L}{dscm} = 1.14\ E{-}05\ \frac{g}{dscm}$$

Volatiles emission rate (g/sec)

$$= 2.57\ E{-}05\ \frac{g}{dscm} \times \frac{10{,}310\ dscf}{\text{min}} \times 2.832.10^{-2}\ \frac{dscm}{dscf} \times \frac{\text{min}}{60\ \text{sec}}$$

$$= 1.25\ E{-}04\ \frac{g}{\text{sec}}$$

Semivolatiles emission rate (g/sec)

$$= 3.43\ E{-}05\ \frac{g}{dscm} \times 10{,}310\ \frac{dscf}{\text{min}} \times 2.832 \times 10^{-2}\ \frac{dscm}{dscf} \times \frac{\text{min}}{60\ \text{sec}}$$

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$$= 1.66\ E{-}04\ \frac{g}{\text{sec}}$$

Nonvolatiles emission rate (g/sec)

$$= 1.14\ E{-}05\ \frac{g}{dscm}\ x\ 10{,}310\ \frac{dscf}{\text{min}}\ x\ 2.832\ x\ 10^{-2}\ \frac{dscm}{dscf}\ x\ \frac{\text{min}}{60\ \text{sec}}$$

$$= 0.554\ E{-}04\ \frac{g}{\text{sec}}$$

Total organics emissions rate (g/sec)

volatiles emission rate + semivolatiles emission rate + nonvolatiles emission rate

$$= 1.25\ E{-}04 + 1.66\ E{-}04 + 0.554\ E{-}04 = 3.464\ E{-}04\ \frac{g}{\text{sec}}$$

Total organic emissions rate (lbs/hr)

$$= 3.464\ E{-}04\ \frac{g}{\text{sec}}\ x\ \frac{lbs}{453.54\ g}\ x\ 3{,}600\ \frac{\text{sec}}{hr}$$

$$= 2.75\ E{-}03\ \frac{lbs}{hr}$$

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Example Action: If all three fractions of the unspeciated mass are not detected, the detection limit value should be used in any subsequent calculations. Lois asks that the facility place a "<" (less than) symbol in front of the value when reporting results in the TBR. If the mass of the volatile unspeciated organic compounds were below the detection limit but the semivolatile and nonvolatile unspeciated mass fractions are quantified, the semivolatiles and nonvolatiles emission rate should be added together and the volatile organic emission contribution can be treated as 0 lbs/hr.

Notes: _____

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11.3.7 Reviewing Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran Emission Rate Results

Regulation: 40 CFR Part 264.343
40 CFR Part 266.104

Guidance: No specific references are applicable to this section of the manual.

Explanation: Regulations require that the emission rates of 2, 3, 7, 8-tetra- through octa-PCDD/PCDF congeners be determined as part of the emission testing for risk assessment purposes. Stack gas emission rate values should be calculated for actual, dry standard, and 7 percent O_2 conditions. The PCDD/PCDF emission rate should be presented as the maximum of three valid test runs for each test condition. The standard deviation and the 95th percentile should also be presented so the reviewer can use this information to assess the variability of the data collected. See Section 8.4.3 of this component for guidance on calculatinag the 95th percentile.

Check For:

- ❑ Trial burn results of PCDD/PCDF emissions
- ❑ PCDD/PCDF emission calculations
- ❑ DRE of 99.9999 percent for PCDD/PCDFs

Example Situation: In reviewing the TBR, Clark uses the following equation to verify the PCDD/PCDF emission rate:

$$MR = 1.323 \; x \; 10E-4 \; x \; C \; x \; Q_s$$

where

MR	=	mass emission rate of PCDD/PCDF (lb/hr)
C	=	concentration of dioxins and furans on dry basis, (mg/dscf)
1.323×10^{-4}	=	conversion factor
Q_s	=	dry volumetric flow rate at standard conditions (dscfm)

C can be estimated as follows:

$$C = K \; x \; m/V_m \; (std)$$

where

K	=	10^{-3} (mg/kg)

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m	=	mass of dioxins and furans in samples (μg)
V_m	=	dry gas volume, measured by the dscf

Example Comments: Clark calculates the same number, verifying the results; no comment is necessary.

Notes: _____

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11.4 REVIEWING PROPOSED PROCESS LIMITS

Regulations: 40 CFR Part 266.102

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 3.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 3.

Explanation: Regulations require that the permit specify process operating limits and risk based limits to include the following:

- Maximum average emission rate for each metal during the trial burn (high temperataure test condition)
- Feed rate of total and pumpable hazardous waste (lower of the maximum value measured during the DRE and high temperature test conditions)
- Fuel feed rates (high temperature test condition)
- Feed rate of metals in each hazardous waste stream (high temperature test condition)
- Total feed rate of Cl_2 and chloride in total feed streams (lower of the maximum value measured during the DRE and high temperature test conditions)
- Maximum combustion gas temperature (high temperature test condition)
- Minimum combustion gas temperature (high temperature test condition)
- Maximum flue gas temperature at the inlet to the PM control device (high temperature test condition)
- Combustion gas velocity (DRE test condition)
- Maximum device production rate (high temperature test condition)
- Minimum device production rate (DRE text condition)
- Appropriate controls on operation and maintenance of the hazardous waste filtering system and any part of the APCS (various)

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- Allowable variation in BIF system design, including any APCS operating procedures (various)
- Risk based limits (risk burn test condition)

Additional guidance regarding the development of permit conditions is included in Component 7—How to Prepare Permit Conditions.

Check For:

- ❑ Maximum (average during test run) emission rate of each metal
- ❑ Feed rate of metals in each hazardous waste stream
- ❑ Total feed rate of Cl_2 and HCl in total feed streams
- ❑ Fuel feed rates
- ❑ Maximum combustion gas temperature
- ❑ Minimum combustion gas temperature
- ❑ Maximum flue gas temperature at the inlet to the PM control device
- ❑ Combustion gas velocity
- ❑ Maximum device production rate
- ❑ Minimum device production rate
- ❑ APCS parameters

Subsections that follow contain procedures for reviewing proposed waste feed limits, AWFCO limits, combustion unit parameters, and APCS parameters. Sections 11.5, 11.6, 11.6.1, 11.6.2, and 11.6.2.1 through 11.6.2.6 of this component include the example comments for review of key process limits.

Example Situation: In reviewing the TBR, Clark notes that the liquid waste feed contains a large amount of chloride; however, the TBR did not propose any process limits for chloride.

Example Action: Clark asks that the facility propose maximum chloride feed rate limits on the basis of the actual trial burn or dispersion modeling conducted using trial burn data.

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11.5 REVIEWING PROPOSED WASTE FEED LIMITS

Regulations: 40 CFR Part 266.102

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 3.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 3.

Explanation: A hazardous waste feed rate limitation is required mainly to minimize a potential loss of efficiency or unsafe situation from overloading the combustion chamber and entire combustion unit treatment system. For maximum operating flexibility, the waste feed rate is maximized during both the DRE and high temperature test conditions.

General guidelines for setting permit limits for waste feed are as follows:

- The maximum feed rate of each LHV waste stream to each combustion chamber should be the feed rate of that stream at the minimum temperature trial burn point
- The maximum feed rate of each medium heating value or HHV waste stream should be the maximum feed rate of that stream for any trial burn point
- The maximum size of containerized waste charged to the combustion chamber should be the maximum demonstrated for any trial burn point

U.S. EPA 1989 Guidance on Setting Permit Conditions lists three approaches for setting waste feed limits, including: (1) single waste/single operating condition - single point; (2) multiple waste/multiple operating conditions - multiple point; and (3) multiple waste/single operating condition - universal. The first approach (single point) applies where only one waste is burned under a single operating condition. The permit objective may be satisfied by setting limits on the specific type of waste to be incinerated.

The second approach is to set multiple limits for each set of operating parameters. For example, when drummed waste is burned with liquid wastes A and B, then one set of operating conditions applies. When drummed waste is burned with liquid wastes C and D, then a second set of operating conditions applies. Each mixture of waste must be defined in the permit under this scenario.

Under the third approach, the intention is to develop one set of operating conditions that allows a facility to burn a relatively broad range of wastes. This approach is most complex; however, it offers the greatest operating flexibility. This approach allows the combustion of a relatively wide variety of wastes but at

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conditions that are generally more severe than most of these waste streams require.

Additionally, annual average permit limits may be established based on data from a risk burn conducted at normal conditions. To develop these additional permit conditions, the minimum and maximum HRAs values demonstrated during the risk burn test are used.

Check For:

- ❑ Whether waste feed rate is the proposed permit limit set at maximum feed rate (review feed rate data of trial burn)
- ❑ Whether the proposed permit limit is established as a single, 1-hour rolling average

Example Situation: In reviewing the TBR, Lois notes that the BIF unit combusts LHV waste and that testing was conducted at minimum and maximum temperature scenarios. The feed rate at the minimum temperature was 45.3 lb/min, whereas the feed rate at the maximum temperature was 47 lb/min. The facility asked to set the maximum feed rate at 47 lb/min.

Example Action: The maximum feed rate limits of each LHV waste stream should be the feed rate of that stream at the minimum temperature trial burn; therefore, a maximum permit limit should be 45 lb/min (unless the permittee desires to and can publicly, legally, and technically defend a higher feed rate limit than what was demonstrated). Lois asks that the facility justify the proposed limit of 47 lb/min.

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11.6 REVIEWING PROPOSED AUTOMATIC WASTE FEED CUTOFF LIMITS

Regulations: 40 CFR 264.345(f)
40 CFR Part 266.102

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2.

U.S. EPA. 1992. "Technical Implementation Document for U.S. EPA's BIF Regulations." EPA-530-R-92-011. Chapter 4.

Explanation: Facilities are required to have AWFCO systems that engage immediately when operating conditions deviate from those established during the trial burn test. Generally, limits for the following parameters are established as AWFCOs:

- Maximum CO concentration in stack gas
- Maximum production rate
- Maximum feed rate of total hazardous waste
- Maximum feed rate of pumpable hazardous waste
- Maximum combustion zone temperature
- Maximum flue gas temperature entering a PM control device
- Limits on key APCS operating parameters

The AWFCO limits are set as HRAs limits based on average data collected during either the DRE or high temperature test conditions.

Check For: This chapter of the TBR should include subsections that address:

- ❑ Combustion unit parameters (see Section 11.6.1)
- ❑ APCS parameters (see Section 11.6.2)
- ❑ Parameters for other associated equipment (see Section 11.6.3)

During review of these subsections, the TBR review team should check for the following:

- ❑ AWFCO limits
- ❑ Whether AWFCO limits are established for the parameters listed above

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Example Situation: In his TBR review, Clark concluded, in part, that:

"This limit is actually a combination of two AWFCO limits (both in lb/hr of waste feed). AWFCO 1, based on the highest average heat input rate from the two test conditions (23.0 million Btu/hr [MMBtu/hr]); and AWFCO 2, based on the maximum waste feed rate demonstrated during TC-2 (45.3 lb/min]).

"According to the TBP, AWFCO 1 will be varied according to the heat content of the waste stream being fed (23.0 MMBtu/hr divided by the heat content) to determine a pound-per-minute waste feed rate limit, not to exceed 45.3 lb/min. The relationship between the two AWFCO limits—which are combined to set a single, HRAs AWFCO for each waste stream—is poorly explained in Section 6.1. In addition, the combination of different units (for example, hours and minutes) may result in an improper calculation of the AWFCO in the future."

Example Action: Clark asks that the facility revise the proposed limits section of the TBR to include a more detailed discussion of the relationship between AWFCOs 1 and 2 for the waste feed rate limit. He also asks that the facility use consistent units in the revisions for values that will be used in the same equation.

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11.6.1 Reviewing Parameters for Combustion Units

Regulations: 40 CFR Part 266.102

Guidance: No specific references are applicable to this section of the manual.

Explanation: 40 CFR Part 266.102(e) requires that the following operating requirements (not inclusive) be specified in the permit:

- Appropriate indicator of combustion gas velocity
  - Gas residence time in the combustion chamber
  - Combustion gas flow rate
  - Combustion air flow rate
- Combustion chamber temperature

The regulations specifically require that suitable interlocks be provided to shut off the hazardous waste feed if the combustion unit temperature drops below a value specified in the permit ([40 CFR Part 264.345(f)]. For maximum operating flexibility, combustion gas velocity (flow rate) is set at as a maximum value to control (1) gas residence time in the combustion chamber, (2) control gas throughout the system to minimize back pressure at joints and seals, (3) gas flow rate through the APCS to ensure that it is not overloaded, and (4) ash carryover from the combustion chamber to the APCS. This value is determined from the maximum average value (instantaneous or HRAs) measured during the DRE test condition of the trial burn test.

Combustion chamber temperature also must to be limited because (1) an increase in combustion zone temperature may lead to increased metals vaporization, which may, in turn, result in increased emissions of hazardous metals; and (2) a decrease in combustion zone temperature may lead to increased PIC emissions. For maximum operational flexibility (worst-case emissions), the combustion unit temperature is bounded by minimum and maximum average values (instantaneous or HRAs) measured during the DRE and high temperature test conditions.

AWFCO limits for combustion chamber temperature are based on the average minimum and maximum operating temperatures at which a successful test (minimum of three runs) occurred. The AWFCO should be set so that the waste feed is cut off when the temperature exceeds these values.

Check For:

- ❑ Whether the proposed permit limit for combustion gas velocity is set at the maximum combustion gas velocity (review gas velocity data during the appropriate test conditions of the trial burn)
- ❑ Whether proposed permit limits for combustion chamber temperature are set at minimum and maximum combustion unit temperatures measured

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during the appropriate test conditions of the trial burn

- ❑ Whether the proposed permit limits are established as both instantaneous and HRA

Example Situation: The limits on flue gas velocity should be based on the maximum combustion gas flow rate measured during the trial burn. This flow rate measurement should be taken at the minimum temperatures observed during the test to ensure that the condition includes the lowest temperatures and shortest residence time that still achieves acceptable combustion unit performance.

In reviewing the TBR, Clark noted that the permit limit for maximum combustion gas velocity is based on the stack gas flow rate demonstrated in the trial burn, with the highest combustion gas flow. Low and high temperatures averaged 15.4 and 14.2 acfm. Therefore, the facility is recommending a 1-hour HRA limit of 14.2 acfm.

Example Action: The permit limit is generally based on low temperature flow measurement data; therefore, a limit of 15.4 acfm should have been proposed. Clark asks that the facility explain the reasoning for proposing the limit at 14.2 acfm.

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11.6.2 Parameters for Reviewing Air Pollution Control Systems

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Various APCSs are used depending on whether it is necessary to control PM, acid gas, or both. Permit limits for APCS parameters for PM and acid gas are based on data collected during the trial burn.

Permit limits for APCS parameters should be set from the results of the appropriate test condition of the trial burn. This approach will maintain compliance while allowing adequate operational flexibility. For example, permit limits for APCS parameters relating to particulate collection should be set from the trial burn test at the maximum average inorganic ash feed rate and the maximum average flue gas flow rate, because the ash feed rate determines the load to the APCS, and an increase in the flue gas flow rate may increase PM entrainment.

Check For: The following subsections should be included (if applicable to the APCS employed):

- ❑ Dry scrubber parameters (see Section 11.6.2.1)
- ❑ Wet ionizing scrubber parameters (see Section 11.6.2.2)
- ❑ Venturi scrubber parameters (see Section 11.6.2.3)
- ❑ Wet scrubber parameters (see Section 11.6.2.4)
- ❑ Electrostatic precipitator parameters (see Section 11.6.2.5)
- ❑ Baghouse (fabric filter) parameters (see Section 11.6.2.6)
- ❑ Other associated equipment parameters (see Section 11.6.3)

The following items should be evaluated by the TBR review team:

- ❑ Proposed permit limits for APCS parameters
- ❑ Trial burn monitoring data for APCS parameters to confirm that proposed permit limits reflect actual APCS monitoring parameters
- ❑ Whether proposed permit limits for APCS parameters are established as HRAs

Example Section: An example section for each type of APCS is included in Sections 11.6.2.1 through 11.6.2.6 and 11.6.3 of this component.

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Example Comments: Example comments for each type of APCS are included in Sections 11.6.2.1 through 11.6.2.6 and 11.6.3 of this component.

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11.6.2.1 Reviewing Dry Scrubber Parameters

Regulation: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have a dry scrubber as part of its APCS. For worst-case emissions, dry scrubber parameters are set at the minimum average caustic feed rate and the maximum average flue gas flow rate, and are typically based on data from successful runs of the DRE test condition of the trial burn. Dry scrubber permit limits are based on the ratio of the flow rate of the absorbent slurry to that of the acid gas, and is stated as "the system should not be operated at a caustic or lime feed rate of less than X lb lime to Y lb HCl."

Check For:

- ❑ Minimum average caustic feed rate
- ❑ Maximum average flue gas flow rate

Example Situation: In reviewing the TBR, Lois notes the following table:

Run Number	1	2	3
Average Flue gas flow (acfm) rate	51	53	53
Average Caustic feed (lb/hr) rate	3.8	4.2	3.9

The TBR proposed a permit limit of 3.8 lb/hr of caustic feed rate.

Example Action: The TBR should have proposed a permit limit of 3.9 lb/hr minimum caustic feed rate, because this rate is the lowest at maximum flue gas flow rate. Lois asks that the facility explain the reasoning behind the proposed feed rate permit limit.

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11.6.2.2 Reviewing Wet Ionizing Scrubber Parameters

Regulation: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have wet ionizing scrubbers as part of its APCS.

The wet ionizing scrubber combines the collection principles of the electrostatic precipitator (ESP) with the acid gas removal of a conventional packed-bed scrubber. In the wet ionizing scrubber, incoming particles are charged in a small ionized section with high-voltage direct current (DC) power. Charged particles are scrubbed in the packed-bed section.

For worst-case emissions, parameters for the wet ionizing scrubber are generally set at (1) minimum HRAs liquid to flue gas ratio; (2) minimum HRAs scrubber blowdown; (3) minimum average pH level of scrubber water; (4) minimum average electric power to the precipitator plates; and (5) maximum gas flow rate, typically based on data collected during successful runs at the DRE test condition of the trial burn.

Check For:

- ❑ Minimum average liquid to flue gas ratio
- ❑ Minimum average scrubber blowdown from the system or maximum suspended solids content of scrubber water
- ❑ Minimum average pH level of the scrubber
- ❑ Minimum average electric power, in kilovolt amperes (kVA) or applied voltage, to precipitator plates
- ❑ Maximum average flue gas flow rate

Example Situation: In reviewing the TBR, Clark notes that the facility has proposed permit limits for only two parameters for the wet ionizing scrubber: minimum liquid flow rate and minimum DC voltage.

Example Action: The parameters listed under "Check For" are typically included as permit limits; however, the facility proposed permit limits for only two parameters. Clark reviews the TBR to determine if all of these parameters were measured during the trial burn in accordance with the TBP, and develops independent permit limit recommendations for the other three parameters.

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11.6.2.3 Reviewing Venturi Scrubber Parameters

Regulation: 40 C Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have venturi scrubbers as part of its APCS.

For worst-case emissions, the liquid-to-gas ratio and the differential gas pressure across the venturi scrubber are set at a value based on the average minimum value measured during the successful runs completed at the DRE test condition of the trial burn.

Check For:

- ❑ Minimum average differential gas pressure limit across the venturi scrubber (the differential pressure is measured by applying pressure taps on each side of the venturi, connected to a differential pressure [$\triangle$P] transducer)
- ❑ Minimum average liquid-to-gas ratio limit
- ❑ pH level limit
- ❑ Maximum total suspended solids
- ❑ Minimum APCS inlet temperature (dry units)

Example Situation: Lois reviews the TBR to see whether the above parameters included under "Check For" were monitored and recorded during the trial burn. She also reviews proposed permit limits for the venturi scrubber to see whether they reflect the minimum average differential gas pressure across the venturi scrubber, minimum average liquid-to-gas ratio, and pH levels recorded during trial burn.

Example Action: Lois reviews trial burn APCS monitoring data to confirm that the $\triangle$P in the permit limit is based on the minimum average $\triangle$P recorded. Typically, the higher the $\triangle$P, the greater the efficiency; therefore, for greater flexibility, $\triangle$P is set at a minimum value.

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11.6.2.4 Reviewing Wet Scrubber Parameters

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have a wet scrubber as part of its APCS.

For worst-case emissions, wet scrubber parameters are set at the minimum average caustic feed rate and the maximum flue gas flow rate typically measured during the successful runs at the DRE test condition of the trial burn.

Check For:

- ❑ Minimum average liquid-to-gas ratio limit
- ❑ Maximum average flue gas flow rate limit
- ❑ pH level limits for scrubber effluent
- ❑ Maximum average inlet temperature
- ❑ Maximum total suspended solids

Example Situation: Clark reviews the TBR to see whether the above parameters included under "Check For" were monitored and recorded during the trial burn. He also reviews proposed permit limits for the wet scrubber to see whether they reflect the minimum average liquid-to-gas ratio, maximum average flue gas flow rate, and pH levels measured during the trial burn test.

Clark notes that since the wet scrubber is used for PM and acid gas control, permit limits are proposed to include minimum liquid-to-gas ratio and maximum flue gas flow rate.

Example Action: Acid gas removal efficiency in the wet scrubber relates directly to the pH of the scrubber effluent. Clark asks that (1) the facility include pH levels for setting wet scrubber permit limits, and (2) the pH limits be based on levels recorded during the actual trial burn.

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11.6.2.5 Reviewing Electrostatic Precipitator Parameters

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have ESPs as part of its APCS.

The ESP is a well-established device for particulate control and is used in very large combustion unit installations. ESPs remove particles by charging them and then collecting them on oppositely charged plates. Collection efficiency increases with increasing applied voltage and decreases with increasing gas flow rate.

For worst-case emissions, ESP parameters are set at minimum electric power to precipitator plates, maximum flue gas flow rate, and maximum average inlet temperature, based on values measured during the successful runs at the DRE or high temperature test conditions of the trial burn.

Check For:

- ❑ Minimum electric power, in kVA or applied voltage, to precipitator plates
- ❑ Maximum average flue gas flow rate
- ❑ Maximum average inlet temperature

Example Situation: Lois reviews the TBR to see whether electric power and flue gas flow rate were monitored and recorded during the trial burn. She also reviews proposed ESP permit limits to see whether they reflect maximum average flue gas flow rate and minimum electric power.

In reviewing the TBR, Lois notes the following table:

Run Number	1	2	3	4	5
Flue Gas Flow (acfm) Rate	89	93	88	91	92
Electric Power to Plates (kVA)	2.8	2.9	2.7	2.7	2.7

The TBR proposed permit limits of 2.7 minimum kVA and a flue gas flow rate of 93 acfm.

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Example Action: Collection efficiency increases with increasing applied voltage. However, to assure the minimum required collection efficiency, the permit limit should be set at minimum kVA at it's corresponding flue gas rate—not the maximum flue gas flow rate demonstrated during trial burn testing. Therefore, the permit limit should be set at 2.7 minimum kVA and 92 acfm, instead of the 93 acfm proposed. Lois asks that the facility revise the proposed permit limit.

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11.6.2.6 Reviewing Baghouse (Fabric Filter) Parameters

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: This section does not apply if the facility does not have a baghouse (fabric filter) as part of its APCS.

Filters remove particles by collecting them on filter fibers or on previously collected particles. The most commonly used types are fabric filters, in which gas flows through parallel arrangements of filter bags. Bags are periodically cleaned by shaking or reversing the air flow. Filter efficiency increases with increasing pressure drop.

In addition to the maximum average inlet temperature, for worst-case emissions, permit limits for a baghouse (fabric filter) are set at minimum average pressure drop based on the data collected during the successful runs completed at the high temperature test condition of the trial burn.

Check For:

- ❑ Minimum average pressure drop, as set by the TBP
- ❑ Maximum average inlet temperature
- ❑ Air-to-cloth ratio
- ❑ Cleaning cycle

Example Situation: Clark reviews the TBR to see whether the pressure drop was monitored and recorded during the trial burn. He also reviews the proposed permit limit to determine if it reflects the minimum average pressure drop observed during the actual trial burn test.

Clark notes that permit limits for fabric filters would be set to include the minimum average differential pressure of 1.5 pounds per square inch (psi) and that the bags would be cleaned once every 3 hours

Example Comments: Normally, a facility need only specify the minimum average differential pressure across fabric filters as a permit condition; however, the facility may also include the cleaning cycle as part of proposed permit limits.

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11.6.3 Reviewing Other Associated Equipment Parameters

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Different types of APCSs are used depending on whether it is necessary to control PM, acid gas, or both. Permit limits for APCS parameters for PM or acid gas are based on the data collected during the trial burn. Section 11.6.2 of this component lists APCS parameters for most commonly used equipment. This section explains how to review other associated equipment parameters, which mainly includes equipment not specifically mentioned in Section 11.6.2 of this component and other parameters formulated on the need to ensure that combustion unit operation adheres to good combustion and APCS operating practices. These latter parameters are based on manufacturer's design and operating specifications rather than trial burn settings. These parameters are established independent of trial burn data.

Check For:

- ❑ Parameters from trial burn data (Group A and B parameters)
- ❑ Cyclones
  - ❑ Inlet gas temperature
  - ❑ Gas velocity
  - ❑ Pressure drop
- ❑ Absorber
  - ❑ Inlet gas temperature
  - ❑ Scrubber liquid flow rate
  - ❑ Scrubber liquid inlet and outlet pH
  - ❑ Nozzle pressure
  - ❑ Recirculation and blow down rate
- ❑ Induced- or forced-draft fan
  - ❑ Volumetric flow rate
  - ❑ Temperature
  - ❑ Pressure
  - ❑ Horsepower
- ❑ Packed-bed scrubber
  - ❑ Liquid-to-gas ratio
  - ❑ Scrubber liquid pH
  - ❑ Scrubber liquor blowdown rate

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- ❑ Parameters independent of trial burn (Group C parameters)
  - ❑ APCS inlet gas temperature
  - ❑ Maximum total heat input for each chamber
  - ❑ Liquid injection burner settings
    - ❑ Maximum viscosity of pumped waste
    - ❑ Maximum burner turndown
    - ❑ Minimum atomization fluid pressure
    - ❑ Minimum waste heating value
  - ❑ Minimum and maximum nozzle pressure to scrubber

Example Situation: In reviewing the TBR, Lois notes that flue gases from the combustion unit are routed to the wet scrubber, and that the average inlet gas temperature to the wet scrubber was 600°F. The wet scrubber was stack tested, and the flue gas temperature was reported at 700°F.

Example Action: The wet scrubber cools the flue gases; therefore, the wet scrubber outlet temperature should be considerably lower than the inlet scrubber temperature. The reported value of 600°F as the inlet temperature appears to be very low. Lois checks the combustion chamber temperature monitoring data to see why 600°F was reported. Based on her review, she finds that the inlet temperature should have been reported as 1066°F. She asks the facility to correct this apparent transcription error from the raw data.

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11.7 REVIEWING PROPOSED DATA FOR USE IN THE RISK ASSESSMENT

Regulations: 40 CFR Parts 266.104, 266.106, and 266.107

Guidance: No specific references are applicable to this section of the manual.

Explanation: Trial burn or risk burn data are collected specifically to conduct human health and ecological risk assessments. These risk assessments ensure the protection of human health and the environment. This data can be collected (1) during normal operating conditions (risk burn data) or (2) at the DRE and high temperature test conditions (trial burn data) depending on the facility and specific requirements identified during the TBP development process.

For each run, the TBR or RBR should summarize the average emission rate for each constituent identified below, calculated at actual, dry standard, and 7 percent O_2 conditions.

Check For:

- ❑ VOC emission rates including PICs, during each run
- ❑ SVOC emission rates including PICs, during each run
- ❑ PAH emission rates during each run
- ❑ Emission rates for other organic compounds that may be of concern, such as aldehydes, during each run
- ❑ Metal emission rate during each run
- ❑ HCl and Cl_2 emission rates during each run
- ❑ PCDD and PCDF emission rates during each run
- ❑ PSD
- ❑ TO emission rates

Example Section: Using emission rate data, a risk assessment is conducted to determine if emissions are greater than a level that may create unacceptable risk. U.S. EPA Region 6 1998 risk protocol documents include specific procedures for completing the risk assessment process at hazardous waste combustion units. This process includes air dispersion modeling, fate and transport modeling, and risk calculation.

Example Action: As part of the TBR review process, Clark reviews and evaluates for accuracy actual stack parameters such as stack gas temperature, stack gas velocity, and stack gas volumetric flow rates to be used in the risk assessment.

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12.0 REVIEWING THE APPENDICES

Regulations: 40 CFR Part 60, Appendix A
40 CFR Part 266
40 CFR Part 266, Appendix IX
40 CFR Part 270

Guidance: No specific references are applicable to this section of the manual.

Explanation: TBR appendices contain all raw test data, field notes, test plans, calculations, and supporting documentation. They also contain performance and QA/QC information. The appendices usually make up the bulk of a TBR, and therefore consume the greatest amount of review time. The review of the main text of the report is a check that the information contained in the report appendices has been accurately summarized.

Check For:

- ❑ The TBP and QAPP would have been submitted and approved prior to conducting the trial burn. They may or may not be resubmitted as appendices; however, if they are not included as appendices to the TBR, they should be obtained for use in the TBR review (see Sections 12.1 and 12.2).
- ❑ Stack sampling report (see Section 12.3)
- ❑ Process sampling report (see Section 12.4)
- ❑ QA/QC report (see Section 12.5)
- ❑ Instrument calibration records (see Section 12.6)
- ❑ Performance calculations (see Section 12.7)
- ❑ Field logs (see Section 12.8)
- ❑ Analytical data packages (see Section 12.9)

Example Situation: During a review of information on waste feed composition, Clark ensures that the following documentation is available for cross-referencing and validation of reported information to verify targeted constituents, approach, methodology, guidance, and limitations: (1) TBP, (2) trial burn QAPP, (3) process sampling report, (4) QA/QC report, and (5) analytical data packages.

Example Action: Clark uses each document for specific information: (1) the TBP outlines waste feed analysis requirements and parameters; (2) the QAPP outlines sample handling, traceability, and reporting criteria; (3) the process sampling report provides detailed information concerning sampling frequency and locations of samples collected during the test; (4) portions of the QA/QC report will verify SQLs and target analysis criteria in support of waste feed analytical procedures;

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and (5) analytical data packages will provide detailed information concerning sample history and raw test data obtained during sample preparation and analysis.

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12.1 REVIEWING APPENDIX A—TRIAL BURN PLAN

Regulations: 40 CFR Part 270.66
40 CFR Appendix A

Guidance: No specific references are applicable to this section of the manual.

Explanation: The TBP should be an appendix to the TBR so that the reviewer can cross-reference information and targeted approaches to the testing program. Component 1—How to Review a Trial Burn Plan, presents TBP elements.

Check For:

- ❑ The TBP must have been submitted and approved prior to the trial burn; it may or may not be resubmitted as an appendix to the TBR; however, at a minimum, it should be obtained for use in the TBR review
- ❑ Letters of correspondence between the BIF facility and the regulatory agency
- ❑ Notices of deficiency and responses
- ❑ Letter from U.S. EPA stating that the TBP is acceptable for implementation

Example Section: The TBP should be thoroughly reviewed, and all participants in the trial burn process—test personnel, field observers, process personnel, and permitting officials—should understand its key components. With this background and understanding, the TBP will assist the TBR reviewer complete the assigned task.

Example Comments: Component 1— How to Review a Trial Burn Plan, provides examples and comments on how to review the TBP.

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12.2 REVIEWING APPENDIX B—QUALITY ASSURANCE PROJECT PLAN

Regulations: 40 CFR Part 270.62(b)(2)
40 CFR Part 270.66(c)

Guidance: No specific references are applicable to this section of the manual.

Explanation: U.S. EPA QA policy requires that every monitoring and measurement project have an approved trial burn QAPP. This document should contain—in specific terms—policies, organizational adaptations, overall objectives, functional activities, and QA/QC activities designed to achieve data quality goals of the project or operation. The trial burn QAPP must be prepared by the organization responsible for the project work, usually the stack sampling contractor, and approved by the appropriate federal, regional, or state agency.

The trial burn QAPP and TBP should be considered companion documents and should be reviewed simultaneously. (For this reason, the trial burn QAPP is often appended to the TBP.)

Check For:

- ❑ The trial burn QAPP should have been submitted and approved prior to the trial burn, it may or may not be resubmitted as an appendix to the TBR; however, as a minimum, it should be obtained to assist in the TBR review.
- ❑ Sixteen essential elements of a trial burn QAPP include:
  - ❑ Title page with provisions for approval signatures
  - ❑ Table of contents
  - ❑ Project description
  - ❑ Project organization and responsibility
  - ❑ QA objectives for later measurement, in terms of precision, accuracy, completeness, representativeness, and comparability
  - ❑ Sampling procedures
  - ❑ Sample custody
  - ❑ Calibration procedure and frequency
  - ❑ Analytical procedures
  - ❑ Data reduction, validation, and reporting
  - ❑ Internal QC checks and frequency
  - ❑ Performance and system audits and frequency
  - ❑ Preventive maintenance procedures and schedules
  - ❑ Specific routine procedures to be used to assess data precision, accuracy, and completeness of specific measurement parameters involved
  - ❑ Corrective action
  - ❑ QA reports to management
- ❑ Document control indicator in the top right corner of each page

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- ❑ How the trial burn QAPP is contained in the overall plan (incorporated into the TBP or separate from it)

Example Section: The trial burn QAPP will describe the accuracy, precision, and data quality objectives for the trial burn test program, including measurement device calibration and tolerance criteria; test methodology criteria; and analysis protocol for the laboratory facilities.

Example Comments: Component 2—How to Review a Trial Burn Quality Assurance Project Plan, provides examples and comments on review of the trial burn QAPP.

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12.3 REVIEWING APPENDIX C— STACK SAMPLING REPORT

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Stack gases are sampled isokinetically at multiple points within a stack for SVOCs, PCDD/PCDFs, PM, HCl, Cl_2, and metals. VOCs and combustion gases are sampled at a constant rate at a single point.

Field data sheets and emission rate calculations should be presented for the following sampling methods if they are part of the trial burn:

- U.S. EPA Method 0010—SVOCs
- U.S. EPA Method 23 or 0023A—PCDD/PCDFs
- U.S. EPA Method 0012 or 0060—Metals
- U.S. EPA Method 0013 or 0061—Hexavalent chromium
- U.S. EPA Method 0030 or 0031—VOST
- U.S. EPA Method 0040—Unspeciated volatile organics
- U.S. EPA Method 0050 or 0051—PM/HCl/chlorine
- Particle size distribution

See Section 10.1.1 of this component for a detailed listing and critical elements of all applicable methods.

Check For: The TBR should include the following subsections:

- ❑ U.S. EPA Method 0010 field data sheets and emission rate calculations (See Section 12.3.1)
- ❑ U.S. EPA Method 23 or 0023A field data sheets and emission rate calculations (See Section 12.3.2)
- ❑ U.S. EPA Method 0012 or 0060 field data sheets and emission rate calculations (See Section 12.3.3)
- ❑ U.S. EPA Method 0013 or 0061 field data sheets and emission rate calculations (See Section 12.3.4)
- ❑ U.S. EPA Method 0030 or 0031 field data sheets and emission rate calculations (See Section 12.3.5)
- ❑ Total organics field data sheets and emission rate calculations (See Section 12.3.6)
- ❑ U.S. EPA Method 0050 or 0051 field data sheets and emission rate calculations (See Section 12.3.7)

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During review of these subsections, the TBR review team should evaluate the following:

- ❑ Field data sheets for each sampling method used during the trial burn
- ❑ Emission rate calculations, in consistent units for each method used during the trial burn
- ❑ Calibration records for pretest and post-test calibration of all methods and sampling equipment
- ❑ All calibration records for calibration equipment

Example Situation: When reviewing TBRs, Lois verifies that all stack sampling reports present the preceding information with appropriate calculations of emission rates.

Example Action: Lois follows Section IV of the U.S. EPA 1989 Checklist for Reviewing RCRA Trial Burn Reports for reviewing RCRA TBRs to confirm that data sheets are complete and accurate.

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12.3.1 Reviewing U.S. EPA Method 0010 Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: Stack gases and particulate pollutants are sampled isokinetically for SVOCs in a multicomponent sampling train. Principal components of the train include a high-efficiency glass or quartz-fiber filter and a packed bed of porous polymeric adsorbent resin. The filter is used to collect organic-laden particulate material, and the porous polymeric resin is used to adsorb semivolatile organic species. Semivolatile species are defined as compounds having boiling points between about 100 and 300°C. Use of the Method 0010 sampling train for the collection of TO emission rate data is described in Section 12.3.6.

A separate field data sheet must be prepared for each sampling run, and this sheet must record each traverse point and sampling time. Critical columns for temperature should be carefully reviewed.

Check For:

- ❑ Field data sheets indicating traverse points sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser
- ❑ Filter temperature of 248 ± 25°F
- ❑ Gas temperature entering the sorbent-trap of less than 68°F
- ❑ Isokinetic sampling rate of 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Minimum sample column calculations
- ❑ SVOC emission rate calculations

Example Situation: In reviewing the TBR, Clark notes that during one test, the filter holder temperature exceeded 273°F for more than 20 minutes of sampling.

Example Comments: Clark asks that the facility note the excursion in the stack sampling report and that its potential impact on data quality be discussed.

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12.3.2 Reviewing U.S. EPA Method 23 or 0023A Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 266.103

Guidance: No specific references are applicable to this section of the manual.

Explanation: The sampling parameters and sampling train are essentially the same as described in Section 12.3.1 of this component.

Check For:

- ❑ Field data sheets indicating traverse points; sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser
- ❑ Minimum sample volume required for DRE measurement is 106 dscf; this volume can be used as the absolute minimum for PCDD/PCDF sampling
- ❑ Filter temperature of 248 ± 25°F
- ❑ Gas temperature entering the sorbent-trap of less than 68°F
- ❑ Isokinetic sampling rate of 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Minimum sample column calculations
- ❑ PCDD/PCDF emission rate calculations
- ❑ Demonstrated experience of the analyst in the use of air sampling methods for PCDDs, PCDFs

Example Situation: In reviewing the TBR, Clark closely examines the field data sheet for each sampling run that will be used for PCDD/PCDF analysis. The sampling time needed to obtain the necessary minimum sample gas volume must be clearly presented.

Example Action: To verify the calculation, Clark uses the formula presented in the TBR for calculating the minimum sampling time:

$$\frac{0.5}{0.85 \; x \; 0.1} = 6.25 \; hr$$

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where 0.5 = analytical detection limit for compound (ng)
0.85 = sample volume (m^3/hr)
0.1 = desired stack gas concentration detection limit (ng/m^3)

The correct result is 5.9 hours. Clark asks that the facility revise the TBR to reflect the correct result.

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12.3.3 Reviewing U.S. EPA Method 0012 or 0060 Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 60 Appendix A, MM5
40 CFR Part 266 Appendix IX

Guidance: No specific references are applicable to this section of the manual.

Explanation: At a minimum, stack gases are sampled isokinetically for the 10 BIF metals antimony, arsenic, barium, beryllium, cadmium, total chromium, lead, mercury, selenium, silver, and thallium. The metals content of the sample is quantitatively determined at the laboratory by using ICP or AA spectroscopy.

Check For:

- ❑ Field data sheets (for each traverse point record: sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger])
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Metals emission rate calculations

Example Situation: In reviewing the TBR, Lois examines all data sheets for metal emission sampling to determine method compliance. The composition of the sampling train apparatus is the same as that used for U.S. EPA Method 5 particulate sampling, with the same temperature limitations.

Example Action: If any of the recorded temperatures exceed limits in the method, Lois verifies that the TBR presents the possible effects on data quality. She is familiar with the U.S. EPA 1989 Checklist for Reviewing RCRA Trial Burn Reports and follows the method requirements checklist carefully.

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12.3.4 Reviewing U.S. EPA Method 0013 or 0061 Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 60 Appendix A, MM5
SW-846 Method 0061
40 CFR Part 266.102(e)(4)

Guidance: No specific references are applicable to this section of the manual.

Explanation: This method applies to the determination of hexavalent chromium emissions from hazardous waste incinerators, BIFs, and other waste combustion sources. The sampling train, constructed of Teflon components, has been evaluated only at temperatures below 300°F. Hexavalent chromium emissions are collected isokinetically from the source. To eliminate the possibility that the level of hexavalent chromium will be reduced between the nozzle and impinger, emission samples are collected with a recirculating train, in which the impinger reagent is continuously recirculated to the nozzle. Impinger train samples are analyzed for hexavalent chromium by an ion chromatograph equipped with a post-column reactor and a visible wavelength detector. The pH in the first impinger must be greater than 8.5 and is to be determined at the end of the sampling run.

Check For:

- ❑ Field data sheets (for each traverse point records: sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger])
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Hexavalent chromium emission rate calculations
- ❑ First impinger pH

Example Situation: After hexavalent chromium sampling has been completed, the technician should record the pH of the first impinger on field data sheets. If nothing is recorded, hexavalent chromium analytical results are suspect.

In reviewing the TBR field data sheets, Clark notes that at the end of Run 1, the technician checked the pH of the first impinger and found it to be 8.3. The solution was analyzed for hexavalent chromium, but in Runs 2 and 3, the first impinger was checked for pH during port change, and additional solution was added to maintain a minimum pH of 8.5. All analytical results appeared to be satisfactory.

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Example Comments: The pH can be adjusted by adding additional sodium hydroxide solution to the impinger or by starting with a higher normality solution to account for acid gas neutralization during sampling.

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12.3.5 Reviewing U.S. EPA Method 0030 or 0031 Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 266.103(e)(2)

Guidance: No specific references are applicable to this section of the manual.

Explanation: This method is for sampling VOCs in stack gas. This method is appropriate for sampling VOCs having a boiling point below 100°C.

This method collects a 20-liter sample of stack gas drawn at a rate of 0.5 liters per minute by using a glass-lined probe and a VOST. The gas stream is cooled to 68°F, and VOCs are collected on two or three sorbent resin traps for Method 0030. The first trap contains about 1.6 grams of Tenax®, and the second trap (back trap) contains about 1 gram each of Tenax® and petroleum-based charcoal. For Method 0031 the first two traps contain Tenax®, while a third trap contains Anasorb®.

Check For:

- ❑ Sample collection rate
- ❑ Temperature of gas stream entering first trap
- ❑ Leak checks
- ❑ Identification of O-rings
- ❑ Identification of sample cartridge storage conditions
- ❑ Qualifications of sampling personnel
- ❑ Holding time for VOST tubes from time and day of collection to time and day of analysis

Example Section: In reviewing the TBR, Lois reviews all data sheets to determine recorded temperatures, sampling rate, and leak checks. She follows the activity column in "Checklist for Reviewing RCRA Trial Burn Reports" for critical functions during VOST operation. Lois pays close attention to the time and date of sample collection and analysis; the holding time is very short for VOST tube analysis.

During review of VOST results, Lois notices that Run 1 samples were collected on May 1 and analyzed on May 19. This delay was not noted in the report as a holding time violation. A comparison of all VOST results showed Run 1 results to be 50 percent lower than other results.

Example Comments: In her report, Lois documents this difference and recommends that VOST testing be repeated.

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12.3.6 Reviewing Total Organics Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 266.10

Guidance: No specific references are applicable to this section of the manual.

Explanation: The characterization of emissions from hazardous waste combustion units should include quantification of the mass emission rate of TO. TO is the combination of three fractions of organic compounds, grouped by boiling points; Group 1—boiling point <100°C; Group 2—boiling point 100°C to 300°C; and Group 3—boiling point >300 °C.

A field GC with a FID is used to analyze an integrated Tedlar® bag sample for organics with boiling points below 100°C. For compounds boiling between 100°C and 300°C and 300°C or higher, samples collected using a U.S. EPA Method 0010 sampling train are analyzed by (1) integrating the total mass under the GC curve (total chromatographicable organics [TCO]) and (2) GRAV after evaporation of all free liquid, respectively.

This combination of two sampling and three analytical techniques provides the investigator with the total mass of all speciated and unspeciated recoverable organic material. The mass of organic material that remains after correction for the speciated organic compounds is used to estimate risk from unspeciated organic emissions.

Check For:

- ❑ U.S. EPA Method 0040 field data sheets
- ❑ Field GC results
- ❑ U.S. EPA Method 0010 field data sheets
- ❑ TCO results
- ❑ GRAV results
- ❑ Unidentified organics emission rate calculations
- ❑ Experience in sampling and analysis techniques

Example Situation: Data from the three analytical determinations are collected and added to obtain a TO value for the sample.

In reviewing the TBR, Clark notes that the following table presents risk burn results:

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Run Number	Semivolatile Chromatographicable Organics (mg/m^3)	Volatile Chromatographicable Organics (mg/m^3)	Total Chromatographicable Organics (mg/m^3)
1	3.051	-----	-----
2	0.589	8.965	-----
3	1.365	0.467	-----
4	------	0.493	-----
Average	1.668	3.308	4.976

Example Action: Clark notes that the math is correct and that the results are representative for a waste-fired boiler using exempt process waste on a unit having no quench or scrubber. Revisions to the guidance for conducting risk assessments at RCRA combustion units have recently included the requirement that TO be measured. However, no GRAV results of the nonvolatile fraction are reported. Clark asks that the facility revise the table to include this information.

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12.3.7 Reviewing U.S. EPA Method 0050 or 0051 Field Data Sheets and Emission Rate Calculations

Regulations: 40 CFR Part 60 Appendix A, U.S. EPA Method 5
U.S. EPA Method 0050, Test Methods for Evaluating Solid Waste, SW-846

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-6-89-019. Chapter 2, Table 5-1, Table 5-4, and Appendix F.

Explanation: Stack gases are sampled isokinetically from the source to collect PM on a glass filter maintained at a temperature of 248 ± 25°F, to collect HCl and Cl_2 gas in absorbing solutions. Particulate mass, which includes any material that condenses at or above the filtration temperature, is determined GRAV after removal of combined water. Chloride content of the absorbing solutions is quantitatively determined at the laboratory by using ion chromatography.

Check For:

- ❑ Field data sheets for each traverse point recording the following:
  - ❑ Sampling time
  - ❑ Vacuum
  - ❑ Stack temperature
  - ❑ Velocity head
  - ❑ Pressure differential across orifice meter
  - ❑ Gas sample volume
  - ❑ Gas sample dry-gas meter inlet and outlet temperature
  - ❑ Temperature of gas leaving condenser (last impinger)
- ❑ Maintenance of proper temperature (probe and filter 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations

Example Situation: Lois and Clark are reviewing field data sheets for U.S. EPA Method 0050 sampling and notice that the oven temperature was recorded at 284°F for several sampling points. Lois remembers that the method states that the oven temperature should not exceed 273°F. If the temperature is too high, some condensible organics will volatilize and not be collected. If the temperature is too low too many compounds will be condensed on the filter, inaccurately reflecting the amount of PM in the stack gas.

Example Action: Lois asks the sampling contractor to explain why the data were not rejected for the run during which oven temperature was above the maximum allowable value.

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12.4 REVIEWING APPENDIX D—PROCESS SAMPLING REPORT

Regulations: 40 CFR Part 266.103
40 CFR Part 270.62(b)(2)(iii)

Guidance: No specific references are applicable to this section of the manual.

Explanation: An appendix to the QA/QC report should describe how process waste samples were collected during the trial burn. This appendix can be cross-referenced to the TBP to determine whether planned samples were collected by using procedures and equipment presented in the TBP.

Check For: The TBR should include subsections on the following:

- ❑ Raw data (see Section 12.4.1)
- ❑ Data summary calculations (see Section 12.4.2)

The TBR review team should evaluate these section for the following information:

- ❑ Sampling equipment, as proposed in the TBP
- ❑ Sampling data forms to see whether location, method, frequency, and presentation agree with TBP
- ❑ Responsibility assignments

Finally, raw data should be spot-checked against data included in the trial burn oversight report.

Example Situation: In reviewing TBR process sampling reports, Clark verifies inclusion of brief sections containing an introduction, a list of responsibilities, any remedial actions taken, the physical method, the procedure described, and any references used. The section on the method is important because it discusses equipment used to collect each sample; the procedure section describes, in detail, how each sample was collected and preserved.

Example Action: Clark verifies that the process sampling report presents the sampling process and determines whether it followed the TBP.

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12.4.1 Reviewing Raw Data

Regulations: 40 CFR Part 270.62(b)

Guidance: No specific references are applicable to this section of the manual.

Explanation: As part of the appendix on process sampling, the TBR must include copies of all process sampling data forms. These forms are usually preprinted for each process sampling station, giving the location, method, frequency, and method of preservation. There are identifiers on the form for the run number, data, and samplers. The form must be completed by the technician collecting the sample.

Check For:

- ❑ Sampling location
- ❑ Sampling method
- ❑ Sampling frequency
- ❑ Sample preservation
- ❑ Run number, data, and sampler identity
- ❑ Sample identification

Raw data should also be spot-checked against data collected during the trial burn oversight

Example Situation: An example of a liquid organic waste feed sampling data form is included as Exhibit 12.4.1-1, see page 6-194. In reviewing data form, Lois and Clark want the following information: (1) contractor identity; (2) facility tested; (3) sample location; (4) sampling method; (5) sampling frequency; (6) sample preservation method; (7) run number; (8) date; (9) sampler; and (10) the grab sample number and time.

Example Action: Lois and Clark expect all TBRs to contain data forms similar to this example.

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EXHIBIT 12.4.1-1

EXAMPLE LIQUID ORGANIC WASTE FEED SAMPLING DATA FORM

[redacted]

LIQUID ORGANIC WASTE FEED SAMPLING DATA

[redacted] Project No. 4341.02.30
Client/Source:
Source Location: [redacted]

SAMPLING LOCATION: In-line, valved tap off tee in feed line leading directly to the dedicated injection nozzle in the primary combustion chamber of the incinerator system. Tee is in 90° bend in feed line where feed flow is downward to tee and horizontal away from tee. Sample flow is downward from tee. Tap located upstream from the point of POHC spike injection into the feed line and is within 15 feet of the injection nozzle.

SAMPLING METHOD: Tap and connections to feed line purged with an adequate amount of feed (approx. 100 mLs) to displace accumulated material immediately prior to each sampling. Samples collected into and composited with a glass beaker to transfer a minimum of 50-mL, but equal volume increments into 32 oz. precleaned, amber glass bottles marked for equal volume graduations; and 40-mL amber glass VOA vials filled from the beaker. Bottles sealed with Teflon®-lined screw caps, and vials sealed with Teflon®-lined septa. All sample containers stored in ice chests during sampling.

SAMPLING FREQUENCY: One (1) composite sample (sample no. XX016) from increments taken and two (2) VOA vials filled every 15 minutes commencing at the start of the run. Sampling conducted continually according to a predetermined schedule except for any adjustments made for port changes on the stack and delays incurred during the run as noted below.

SAMPLE PRESERVATION: All samples stored at near water ice temperature (i.e., 4°C).

Run No. 1 Date: 11-6-96 Sampler(s): [redacted]

Feed Tank No. 2 Feed Pump No. 2

Composite Sample Number: XX016 XX041 XX042 XX041 and XX042 are prepared
Composite Sample Designation: SVOC GALBT* GALBT* (i.e., composited) after the run*

Grab No.	Time	VOC VOA No.	VOA Sample Number	GALBT VOA No.	VOA Sample Number	Interruptions/Comments
1	1300	1	XX017	1	XX029	Brown liquid w/ Black particles.
2	1315	2	XX018	2	XX030	
3	1330	3	XX019	3	XX031	
4	1345	4	XX020	4	XX032	
5	1545	5	XX021	5	XX033	
6	1600	6	XX022	6	XX034	
7	1615	7	XX023	7	XX035	
8	1630	8	XX024	8	XX036	
9	1645	9	XX025	9	XX037	
10		10	XX026	10	XX038	
11		11	XX027	11	XX039	
12		12	XX028	12	XX040	

*POSTSAMPLING OPERATIONS: GALBT Sample VOA vials composited by transferring contents of vials to a 16 oz. precleaned, amber glass bottle (Sample Number XX041), then mixing and transferring a portion of the mixture to a 40-ml. amber glass VOA vial (Sample Number XX042) leaving no headspace. Bottle sealed with Teflon®-lined screw cap and vial sealed with Teflon®-lined septum. Samples stored at near water ice temperature (i.e., 4°C).

Relinquished By [redacted] Received By [redacted] Date/Time 11/6/96 1800

FCLOA2VX.WPD November 5, 1996 (rev. 1 to 1 of 1 D.WPD November 5, 1996)

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12.4.2 Reviewing Data Summary Calculations

Regulations: 40 CFR Part 266.103
40 CFR Part 270.62

Guidance: No specific references are applicable to this section of the manual.

Explanation: For each major measurement parameter, a brief description of the following should be included:

- Data reduction scheme for nonroutine methods, including all validation strips and equations used to calculate final results
- List of all final experimental data to be reported in the TBR
- List of all QC data to be reported in the TBR

All reportable test and QC data must be identified. Data summary calculations should be clear and easy to follow.

Check For:

- ❑ Presentation of summary calculations
- ❑ Whether summary calculations are complete
- ❑ Whether summary calculations are accurate

Example Situation: In reviewing data summary calculations (supporting documentation to the TBR), Lois reads as follows:

"All data will be recorded on a digital storage device for qualitative and quantitative data reduction. All data will be reviewed from the time samples are collected through analytical data reduction, to determine whether they are reusable."

Example Action: Lois asks that the facility provide example calculations based on actual data for all results of analysis for critical parameters, particularly the DRE of POHCs and stack emissions.

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12.5 REVIEWING APPENDIX E—THE QA/QC REPORT

Regulations: 40 CFR Part 266.103
40 CFR Part 270.62

Guidance: No specific references are applicable to this section of the manual.

Explanation: The trial burn QAPP should outline the QA/QC information from the trial burn that will be reported; this information includes the 16 elements presented in Section 12.2 of this component. The TBR should contain all field records, all calibration data (analytical and field), all precision and accuracy determinations associated with QA objectives (such as surrogates, spikes, duplicates, and standard reference material), all internal audits, and the data quality assessment report from the QA/QC coordinator.

In general, the following QA/QC information should be provided:

- Sample traceability
- Holding times
- Waste, fuel, and APCS sampling
- Stack gas sampling
- Analysis
- QC assessment
- QA/QC coordinator report

Check For: This section of the TBR contain subsections that include the following:

- ❑ Field sampling QA/QC report (see Section 12.5.1)
- ❑ Laboratory QA/QC report (see Section 12.5.2)
- ❑ COC forms (see Section 12.5.3)

The TBR review team should evaluate the following aspects of this information:

- ❑ Formal presentation of the 16 trial burn QAPP elements
- ❑ QA/QC information on items listed in the explanation
- ❑ Consistency between TBP, trial burn QAPP, and TBR presentation

Example Situation: In reviewing the TBR, Clark reads as follows:

"Section 6—Sampling Procedures During the Test Burn

"6.1 Procedures - The sampling procedures to be used in this program are described in Section 5 of the TBP and Appendix A of Volume 3. This section

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provides information on the adequacy of the sampling and analysis methods for demonstrating incinerator performance."

Example Action: Clark notes Section 6.1 provides a good cross-reference to the TBP and Appendix A, and he is able to quickly locate planned and actual activities.

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12.5.1 Reviewing Field Sampling Quality Assurance/Quality Control Report

Regulations: 40 CFR Part 60 Appendix A, MM5
40 CFR Part 266 Appendix IX

Guidance: No specific references are applicable to this section of the manual.

Explanation: These documents list, and contain checklists for, stack QA/QC procedures for gas sampling.

Check For: Using the checklists, the reviewer should evaluate the following:

- ❑ U.S. EPA Method 1
  - ❑ Absence of cyclonic flow
- ❑ U.S. EPA Method 2
  - ❑ Thermocouple calibration range and date
  - ❑ Barometer calibration range
- ❑ U.S. EPA Method 3
  - ❑ Leak check for sampling
  - ❑ Leak check for analyzers
- ❑ U.S. EPA Method 4
  - ❑ Calibration sheets for vacuum gauge
  - ❑ Calibration sheets for thermocouples
  - ❑ Calibration sheets for dry-gas meter
  - ❑ Proper sampling rate
  - ❑ Pump leak checked
  - ❑ Leak check on train
  - ❑ Train temperature less than 68°F
- ❑ U.S. EPA Method 5
  - ❑ Calibration sheets for sampling nozzle, pitot tube, dry-gas meter and thermometers/thermocouples
  - ❑ Leak checks for sample line and pitot lines
  - ❑ Proper sampling rate
  - ❑ Adequate total sampling time (2-hour minimum) and sampling time at each point
  - ❑ Proper temperature maintained (probe and filter 240 ± 25°F, train exit gas less than 68°F)
  - ❑ Sampling rate within 90 to 110 percent of isokinetic

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- ❑ U.S. EPA Modified Method 5 (U.S. EPA Method 0010) for semivolatile organics

  - ❑ Sample recovery documentation for XAD tubes
  - ❑ Sample recovery documentation for blank sample collection
  - ❑ Calibration sheets for sampling nozzle, pitot tube, dry-gas meter and thermometers/thermocouples
  - ❑ Leak checks for sample line and pitot lines
  - ❑ Proper sampling rate
  - ❑ Adequate total sampling time (2-hour minimum) and sampling time at each point
  - ❑ Proper temperature maintained (probe and filter 240 ± 25°F, train exit gas less than 68°F)
  - ❑ Sampling rate within 90 to 110 percent of isokinetic

- ❑ U.S. EPA Methods 0012 and 0060 - Determination of Metals Emissions from Stationary Sources. Review method for QA/QC procedures and proper sample collection, transfer, and train component cleanup

- ❑ U.S. EPA Methods 0030 and 0031 for volatile organics

  - ❑ Leak checks for the train
  - ❑ Calibration sheets for dry gas meter and thermocouples
  - ❑ Sampling volume, duration, and leak checks for each trap pair recorded
  - ❑ Trip blanks collected
  - ❑ Field data logsheets for each trap pair available

- ❑ U.S. EPA Method 0040 - Total Organics Measurement. Review method for QA/QC procedures and field analytical requirements

- ❑ U.S. EPA Methods 0050 and 0051 - Sampling Method for PM, HCl and Cl_2. Check method for QA/QC, sampling requirements, transfer and train cleanup

- ❑ CO and O_2 CEMS

  - ❑ Leak checks for CO and O_2 sampling locations
  - ❑ Calibration gas concentration (zero and high level)
  - ❑ Calibration gas certificate (whether CO protocol calibration gases have expired)
  - ❑ Whether calibration checks are performed before each run and daily
  - ❑ Whether zero and span calibration drift test is performed during trial burn
  - ❑ Whether sampling and analysis are conducted every 15 seconds during trial burn
  - ❑ Whether data are logged every 60 seconds during trial burn

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Example Situation: In reviewing the sampling equipment calibration data (an appendix to the TBR), Lois checks data sheets for traverse point location, velocity traverse data (includes cyclonic flow check), sampling nozzle calibration check data sheet, aneroid barometric calibration check, U.S. EPA Method 5 metering console calibration with critical orifice, console calibration worksheet, console post-test checklist, pyrometer calibration data form, Type S pitot tube inspection data forms, and other stack sampling data forms.

Example Action: Lois notes that the TBR does not present all calibration data needed for stack sampling equipment; missing are the dry-gas meter calibration data and flow meter calibration data. Lois asks that the facility add the information to the TBR appendix.

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12.5.2 Reviewing Laboratory Data Summary Report

Regulations: 40 CFR Part 266.103
40 CFR Part 270.62

Guidance: No specific references are applicable to this section of the manual.

Explanation: All reportable test and QC data must be identified. QC data are often neglected in TBRs, but they are vital to assessing overall data quality.

The trial burn QAPP should outline QA/QC information from the trial burn, including: (1) all field records; (2) all calibration data (analytical and field); (3) all precision and accuracy determinations associated with QA objectives (such as surrogates, spikes, duplicates, and standard reference material); (4) all internal audits; (5) the data quality assessment report from the QA Coordinator; and (6) a detailed discussion outlining the method used to determine SQLs for all analytical methods used.

Precision and accuracy determinations should be clearly presented, with all results calculated. Any value that falls outside the data quality objective should be flagged in data tables and discussed in the text in terms of the affect of the apparent problem on overall sample results.

Check For:

- ❑ Identification of all reportable data
- ❑ Presentation of field records
- ❑ Calibration data
- ❑ Precision and accuracy results
- ❑ Internal audit results
- ❑ Data quality assessment report
- ❑ SQL determination summary
- ❑ Flagged data with discussion

Example Situation: In reviewing the TBR, Clark reads as follows:

"Section 6.1. Performance Audit Results"

"Performance audit samples were prepared and analyzed with the field test samples as a measurement of accuracy. The samples were intended to provide an independent verification of accurate calibration or to simulate actual test samples (that is, audit samples that are prepared and analyzed concurrently with test samples). With a few minor exceptions, the results of performance audit

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samples were within normal calibration tolerances and data quality objectives of the QAPP."

Example Action: Although the report acknowledges that there were exceptions to meeting the performance audit goals, it does not discuss the overall significance of these exceptions. Clark asks that the facility include a discussion addressing this issue.

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12.5.3 Reviewing COC Forms

Regulations: 40 CFR Part 266.62

Guidance: No specific references are applicable to this section of the manual.

Explanation: An essential part of any sampling and analytical scheme is ensuring the integrity of the sample from collection to data reporting. The possession and handling of samples should be traceable from the time of collection through analysis and final disposition. This documentation of the sample history is referred to as COC. COC documentation is necessary if there is any chance that analytical data, or conclusions based on analytical data, will be used in litigation. In cases where litigation is not involved, many COC procedures are still useful for routine control of sample flow.

Check For:

- ❑ Completed forms
- ❑ Signatures
- ❑ Sample identification
- ❑ Other information, as required

Example Situation: In reviewing the TBR, Lois reads as follows:

"7.5. Section Transfer and Shipment of Samples—When transferring possession of samples, individuals relinquishing and receiving those samples will sign, date, and note the time on the field sample custody record. This record documents sample transfer from the field sample custodian, often through another person or commercial carrier, to the laboratory sample custodian or analyst."

Example Action: Lois determines that the attached *Sample Traceability Record and Sample Condition at Receiving Laboratory* forms meet the basic requirements of a COC form and enables her to track the sample from collection to analysis.

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12.6 REVIEWING APPENDIX F—INSTRUMENT CALIBRATION RECORDS

Regulations: 40 CFR Part 60 Appendix A

Guidance: No specific references are applicable to this section of the manual.

Explanation: During a trial test, many types of instruments, equipment, and measuring devices are used to measure and record source operational characteristics, physical parameters, and scientific data. These devices are used to measure data associated with the process, control device, ancillary unit operations, and sampling test equipment.

The TBP and trial burn QAPP should identify each measuring device and discuss its calibration content and tolerance.

Check For:

- ❑ Process monitoring equipment calibration records (see Section 12.6.1)
- ❑ Process control equipment calibration records (see Section 12.6.2)
- ❑ Emission monitoring equipment calibration records (see Section 12.6.3)
- ❑ Stack gas sampling equipment calibration records (see Section 12.6.4)
- ❑ Field analytical equipment calibration records (see Section 12.6.5)

The TBR review team should closely check this information for consistency with the trial burn oversight report.

Example Situation: In reviewing the TBR, Lois locates a list of test devices and tolerance criteria requirements in the TBP and trial burn QAPP. She uses these lists to verify that all calibration records contained in the TBR are presented and that targeted tolerance criteria are satisfied.

Example Action: Lois notes that the TBR presents all of the following, in accordance with U.S. EPA trial burn test requirements: (1) all instruments, monitors, equipment, and measuring devices identified in the TBP, and (2) calibration factors, tolerance values, and adjustment values outlined in the trial burn QAPP.

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12.6.1 Reviewing Calibration Records for Process Monitoring Equipment

Regulations: 40 CFR Part 266.104(b)
40 CFR Part 266.105(a)
40 CFR Part 266.106(I)
40 CFR Part 266.107
40 CFR Part 270.62(b)(ii)(F and J)

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-89-019. Chapter 5.

Explanation: For U.S. EPA to approve testing and sampling activities, the TBP must identify various equipment and measuring devices used to monitor process equipment. The manufacturers of these devices generally calibrate them before sale and installation in the process. U.S. EPA requires that these devices be maintained and operated in accordance with manufacturer procedures, to ensure that valid and reproducible results can be obtained and verified. In addition, the devices must be calibrated before a trial burn test, and the calibration information and procedure must be documented to verify conformance with the TBP and trial burn QAPP.

Check For:

- ❑ List of process monitoring equipment and measurement devicesoutlined in the TBP
- ❑ Identification and response criteria of each process monitoring device outlined in the trial burn QAPP

The TBR review team should closely check this information for consistency with the information presented in the trial burn oversight report.

Example Situation: In reviewing the TBR, Clark noted that the TBP identified process monitoring equipment devices in tabular form, and that the trial burn QAPP presented the tolerance range and sensitivity requirements for each monitoring device in tabular form. These two tables were photocopied and readily available during review of the calibration records appendix section of the TBR. Clark used the tables to verify calibration records, including forms and worksheets, and found that tolerance and sensitivities were within proposed specifications.

Example Comments: Use of the process monitoring equipment list outlined in the TBP and equipment specifications outlined in the trial burn QAPP assists Clark in a timely and organized approach to verify calibration records.

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12.6.2 Reviewing Calibration Records for Process Control Equipment

Regulations: 40 CFR Part 266.103
40 CFR Part 266.104(b) and (c)
40 CFR Part 266.105
40 CFR Part 266.106
40 CFR Part 266.107
40 CFR Part 270.62
40 CFR Part 270.66

Guidance: U.S. EPA. 1989. "Guidance on Setting Permit Conditions and Reporting Trial Burn Results." EPA-625-89-019. Chapter 5.

Explanation: The TBP must identify devices used to monitor and measure process control equipment in a manner similar to the preceding section for reviewing process monitoring equipment calibration records.

Check For:

- ❑ List of the process control equipment measuring devices outlined in the TBP
- ❑ Calibration records
- ❑ Identification and response criteria of each process control equipment device outlined in the trial burn QAPP

The TBR review team should closely check this information for consistency with the trial burn oversight report.

Example Section: To review the calibration records for the process control equipment, Lois located the tabulated summary of process control monitoring equipment in the TBP and the tabulated summary of calibration criteria in the trial burn QAPP. She then prepared a photocopy of each table, and began to review the calibration records presented in the trial burn test report—verifying that each device and calibration value was present and within the proposed specifications.

Example Comments: Lois found that the use of these tables assisted her in conducting a complete and thorough review of the measuring devices and the calibration records. She did not note any problems.

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12.6.3 Reviewing Calibration Records for Continuous Emission Monitoring Equipment

Regulations: 40 CFR Part 60 Appendix A

Guidance: No specific references are applicable to this section of the manual.

Explanation: The use of CEMS by the test firm should follow the procedures outlined in the appropriate U.S. EPA reference methods. The reference test methods and parameters commonly measured during a trial burn test are as follows:

U.S. EPA Reference Method	Parameters
3A	O_2 and CO_2
6C	Sulfur dioxide
7E	Nitrogen oxides
10	CO
25A	Total hydrocarbons

Before and after the test period, the CEMS is calibrated with reference gas standards. The response of the monitor to the gas standards is used to verify calibration error, zero drift, calibration drift, and sampling system bias tolerance criteria outlined in each U.S. EPA reference method.

Check For:

- ❑ Monitor calibration error for all gases
- ❑ Zero drift of the monitor
- ❑ Calibration drift of the monitor
- ❑ Sample system bias of the monitor

The TBR review team should closely check this information for consistency with the trial burn oversight report.

Example Section: The stack sampling company measured O_2 concentration, with a CEMS using U.S. EPA reference Method 3A. The calibration results after the test period were found to be as follows:

Zero drift	=	1 percent of the span
Calibration drift	=	1.5 percent of the span
Calibration error (zero gas)	=	1 percent of the span
Calibration error (mid-range gas)	=	1 percent of the span
Calibration error (high-range gas)	=	1 percent of the span
Sampling system bias (mid-range gas)	=	2 percent of the span

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Example Comments: The calibration criteria of an O_2 CEMS according to U.S. EPA reference U.S. EPA Method 3A are as follows:

Zero drift	=	< ± 3 percent of the span
Calibration drift	=	< ± 3 percent of the span
Calibration error (zero gas)	=	< ± 2 percent of the span
Calibration error (mid-range gas)	=	< ± 2 percent of the span
Calibration error (high-range gas)	=	< ± 2 percent of the span
Sampling system bias (mid-range gas)	=	< ± 5 percent of the span

Based on a comparison of the O_2 monitor response to the calibration gases and the criteria of U.S. EPA reference method 3A, the monitor satisfies all criteria requirements of the methodology.

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12.6.4 Reviewing Calibration Records for Stack Gas Sampling Equipment

Regulations: 40 CFR Part 266 Appendix IX
40 CFR Part 60 Appendix A

Guidance: No specific references are applicable to this section of the manual.

Explanation: The regulations require measurement devices to meet design criteria, tolerance specifications, and various calibration protocols. The U.S. EPA reference methods require the stack testing company to provide calibration records or worksheets of pitot tubes, thermocouple, dry gas meter, barometer, nozzle, and other devices used for trial burn test projects.

Check For:

- ❑ Pitot tube calibration form
- ❑ Thermocouple calibration form
- ❑ Dry-gas meter calibration form (pretest and post-test)
- ❑ Barometer calibration form
- ❑ Sample train nozzle calibration form

Example Section: Lois notes that the stack sampling company provided a calibration record form for a barometer used during the trial burn test. The barometer was calibrated against the barometric readings at a nearby weather bureau, at an identical elevation relative to sea level.

Example Comments: The barometric pressure at the weather bureau and the readings of the field barometer were identical at the same elevation. Since the calibration of the field barometer is considered complete and satisfactory for a trial burn test, Lois determined that the field readings were insufficient since at the test site were at the same elevation as the weather bureau.

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12.6.5 Reviewing Calibration Records for Field Analytical Equipment

Regulations: No regulations are applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: Many source testing companies use portable and field analytical equipment on location during trial burn tests. This equipment may include gas chromatography, pH meter, conductivity meter, and spectrometers. The use of these instruments on location facilitates evaluating emissions during testing, reducing or eliminating sample shipment, and reduces laboratory turnaround times.

Calibration, precision, accuracy, and completeness requirements of the methodology must be consistent with the trial burn QAPP and TBP objectives.

Check For:

- ❑ Pre- and post-test calibrations
- ❑ Sampling system bias evaluations
- ❑ Equipment performance and percent recovery
- ❑ Spike and matrix spike evaluations

Example Section: A source testing company uses a pH meter to continuously monitor the pH of the first impinger of a hexavalent chrome sampling train. Before and after the test run, the pH meter is calibrated with known buffer solutions at pH 4 and pH 7 to show that the instrument is maintaining stability and precision over the test sampling period.

Example Comments: According to the hexavalent chrome test methodologies, the pH of the absorbing solution must be greater than 8.5 after the test run is completed. Although the testing company calibrated the instrument appropriately; the calibration range should have been a pH of 7 to 10, Lois asks the facility to include in the TBR a discussion of the impacts of this deviation.

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12.7 REVIEWING APPENDIX G—PERFORMANCE CALCULATIONS

Regulations: 40 CFR Part 266.104

Guidance: No specific references are applicable to this section of the manual.

Explanation: BIFs burning hazardous waste must achieve a DRE of 99.99 percent for all POHCs in the waste feed, and the DRE of 99.99 percent must be demonstrated during the trial burn for each POHC. Rounding up to achieve the required DRE is not allowed.

Check For:

- ❑ DRE calculations
- ❑ DRE of at least 99.99 percent for each POHC (during each run) identified during the trial burn
- ❑ DRE of at least 99.9999 percent for PCDD/PCDFs, if applicable

Example Section: The DRE for each POHC can be verified by using the following equation:

$$DRE = (1 - \frac{W_{out}}{W_{in}}) \; x \; 100$$

where

W_{out} = mass feed rate of one POHC in stack gas before release to the atmosphere

W_{in} = mass feed rate of same POHC in the hazardous waste fired to the BIF

Example Comments: The mass of each POHC entering the BIF can be calculated using the waste feed analytical results and mass feed rate to the BIF. The mass of POHCs in the flue gas can be calculated on the basis of (1) the average stack gas flow rate for the isokinetic sample train from which the sample was collected, and (2) the analytical results from stack samples. For VOCs (which are collected on a nonisokinetic sampling train), the average stack gas flow rate for isokinetic sampling trains operating at the same time should be used.

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12.8 REVIEWING APPENDIX H—FIELD LOGS

Regulations: No regulations are applicable to this section of the manual.

Guidance: No specific references are applicable to this section of the manual.

Explanation: It is customary for field logs to be maintained during a trial burn test. Notes may be logged by the source testing field team leader, facility coordinator, regulatory agency observer, or an independent third-party monitor. Field log information may contain information related to operation upsets, test problems, equipment failures, and various forms of checklists.

Check For:

- ❑ Notes or logs by program coordinator, unit operation, process, or control room operators of the facility
- ❑ Notes or logs recorded by source testing company coordinator, field crew leader, and equipment operators
- ❑ Notes, logs, or checklists taken by U.S. EPA, state regulatory, and contracted oversight observers
- ❑ Field notes, logs, or checklists prepared by an independent third-party auditor

Example Section: During the review of a TBR, Clark observed that project participants were listed in tabular form. He also looked at the oversight report appendix presenting field log notes and discovered that the U.S. EPA-subcontracted observer had recorded all facility and test personnel involved during the trial burn test on a day-by-day basis.

Example Comments: It was simple to cross check the project participant list in the TBR by comparing the tabulated list with the handwritten field notes recorded by the subcontracted observer present on the test day. Clark did not note any discrepancies.

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12.9 REVIEWING APPENDIX I—ANALYTICAL DATA PACKAGES

Regulations: 40 CFR Part 270.62(b)(2)(I)(A - D)

Guidance: No specific references are applicable to this section of the manual.

Explanation: The appendix of a TBR contains the reports and analytical data information prepared by the laboratory contracted to analyze waste feed, process, and stack gas samples. A thorough and careful review of laboratory analytical data packages contained in the TBR appendix will facilitate and streamline the verification of test results. In addition, all laboratory QA/QC information is presented, and expected and targeted criteria can be compared and verified with this complete QA/QC information.

Check For:

- ❑ Analytical data package for waste feed parameters
- ❑ Analytical data package for process samples
- ❑ Analytical data package for stack gas samples
- ❑ Information presented in the data packages for:
  - ❑ Sample identification name and number
  - ❑ Analytical method followed
  - ❑ Matrix type
  - ❑ Date, time, and location of sample collection
  - ❑ Person responsible for sample collection and recovery
  - ❑ Temperature of sample when received
  - ❑ Result of the sample analysis and units associated with the number valve
  - ❑ Method detection limit and sample quantitation limit
  - ❑ Spike results
  - ❑ Spike recovery
  - ❑ Matrix spike results
  - ❑ Duplicate matrix spike results
- ❑ Whether the QA/QC objectives of the TBP were met and satisfied
- ❑ Whether the QA/QC objectives of the trial burn QAPP were met and satisfied

Example Section: Clark was comparing BIF metal stack test emission results against the laboratory report contained in the appendix. His comparison showed different concentration results, and further examination revealed that the units associated with the reported values were different. Based on the units outlined in the laboratory report, Clark calculated the metal emissions and concluded that the results presented were incorrect.

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Example Comments: Clark prepared a comment requesting that the facility recalculate the metal emission.

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ATTACHMENT A

MEMORANDUM ON TRIAL BURNS

(11 Sheets)

United States Environmental Protection Agency
Solid Waste and Emergency Response (5305)
EPA530-F-94-023
July 1994

EPA

Memorandum on Trial Burns

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL - 5 1994

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

SUBJECT: Guidance on Trial Burn Failures

FROM: Michael Shapiro, Director
Office of Solid Waste

TO: Hazardous Waste Management Division Directors
Regions I-X

The purpose of this memorandum is to clarify EPA's policy on trial burns for incinerators and boilers and industrial furnaces (BIFs) under the Resource Conservation and Recovery Act (RCRA), and to address issues that have recently been raised regarding trial burn failures. These issues include: 1) what constitutes a successful trial burn; 2) how to handle invalid data; 3) what constitutes an unsuccessful trial burn; 4) how to handle a request for a trial burn retest; and 5) how to restrict operations after an unsuccessful trial burn.

The policies set out in this memorandum are not final agency action, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

Purpose of a Trial Burn

A trial burn serves several purposes. It is used to determine whether a facility can meet the required performance standards for either hazardous waste incinerators (40 CFR 264.343) or BIFs (40 CFR Part 266 Subpart H), and to determine the operating conditions that should be set in the permit. A trial burn is also used by the permit writer to determine the need for and establish other limits or requirements on a site-specific basis under the "omnibus" authority of RCRA Section 3005(c)(3). This guidance will consider the term "performance

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standards" to include both regulatory performance standards and such site-specific standards imposed through the omnibus authority. Until continuous emission monitors (CEMs) are available, setting permit operating conditions based on the results of trial burns is the best method of assuring compliance with the regulations.

A trial burn typically consists of a series of "tests". A trial burn test (or combination of tests) should be done for each set of operating conditions for which the facility desires to be permitted. Three "runs" should be performed for each test. Each run of a test should be conducted at the same nominal operating conditions. In general, each run of a test should be passed for the test to be considered successful and for the facility to be permitted to operate at that set of conditions.

Facilities will often perform multiple tests during the trial burn in order to develop all applicable permit operating conditions. For example, facilities will usually perform a minimum and a maximum temperature test, since decreasing temperatures tend to decrease organics destruction, and increasing temperatures tend to increase metals emissions due to an increase in volatility. These tests, if successful, will determine the temperature boundaries between which the facility can operate in compliance with the destruction and removal efficiency (DRE) and metal emissions standards.

During a trial burn, a facility's general strategy is typically to operate at conditions that will give it a broad range of permit operating conditions. The permit writer should take great care in reviewing the trial burn plan to assure that the test conditions meet the regulatory requirements. According to 40 CFR 270.62(b)(5) for incinerators and 40 CFR 270.66(d)(2) for BIFs, the trial burn plan can only be approved if 1) it is likely to determine if the performance standards can be met, 2) it does not present an imminent hazard to human health or the environment, and 3) it will help to determine the necessary operating requirements. In determining if the performance standards can be met in the trial burn, permit writers should use their experience and best engineering judgement to make sure that the trial burn represents "good operating practices". EPA believes that a trial burn plan that allows or incorporates sub-standard operating practices is less likely to demonstrate compliance with required performance standards than a plan based on a well-operated unit. The Combustion Emissions Technical Resource Document (CETRED), which helps to define best operating practices for various categories of hazardous waste combustors, can assist in determining good operating practices. Engineering judgement and generally accepted industry practices for achieving good mixing, adequate temperatures and residence times, adequate oxygen, steady-state operation, and minimization of fugitive emissions can also be used in this evaluation. Additionally, in

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reviewing and approving a trial burn plan, the permit writer may find it useful to examine the facility's compliance history and past operating history when applicable.

What Constitutes a Successful Trial Burn

A trial burn is successful only if enough tests are passed so that the permit writer can establish a complete set of operating conditions in the permit to assure compliance with applicable performance standards. A successful trial burn test generally consists of passing three separate runs at the same nominal operating conditions. If a test is successful, the facility would be allowed to operate under the tested conditions. In general, failing any performance standard in any one of the three runs constitutes a failure of that test. If a test fails, the facility should not be permitted to operate under the failed conditions.

A facility may fail an individual test (or several tests) at particular operating conditions during the trial burn; however, if sufficient tests are passed such that applicable permit operating conditions can be established from the successful tests, then the trial burn is still considered successful. For example, for a facility where maximum and minimum temperature limits are necessary, the facility would typically have to pass both a minimum temperature test and a maximum temperature test, along with any other necessary tests, for the trial burn to be successful.

Facilities can receive final permit conditions for only those conditions that they passed in the trial burn or that are set independent of the trial burn (e.g., Tier I metal limits, which are discussed later in this document). Thus, in a case where a facility passed some tests and failed others, it is important to be able to distinguish the difference between the successful and unsuccessful conditions. Final permit conditions should be written to allow the facility to operate at the successful conditions while excluding the unsuccessful ones. Additionally, the permit writer should be sure to set monitoring and recording requirements in the permit to assure that operating conditions are being met.

Final permit conditions will directly reflect the successful operating conditions from the trial burn. Due to unforeseen circumstances that may arise during trial burns, the trial burn conditions may deviate somewhat from the conditions specified in the trial burn plan. If this situation occurs, and the trial burn was successful, the operating conditions in the permit should be the conditions demonstrated during the trial burn, not the conditions from the trial burn plan. In other words, for conditions that are set based on the trial burn, a facility will

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be permitted to operate only at those conditions that have been demonstrated successfully during the trial burn.

Facilities may perform several tests during a trial burn in an attempt to have different sets of operating conditions for different sets of wastes (i.e., "campaign burning"). If a facility fails a particular test, it may still be permitted to operate on those waste streams and at those conditions that were successfully demonstrated, provided that sufficient data are available from the passed tests to set all necessary permit operating conditions. If trial burn results do not provide sufficient data to enable the Agency to set permit conditions which assure compliance with the performance standards, then the trial burn would not be considered successful.

How to Handle Invalid Data

In limited situations, the Agency believes it may be appropriate to use data from two successful runs as the basis to determine that a trial burn test was successful when circumstances beyond the owner/operator's control caused the invalidation of a third run. An invalid run is different from a failed run. A failed run occurs when the data show nonconformance with the performance standards under a particular set of operating conditions. An invalid (or inconclusive) run occurs when data problems (for example, resulting from breakage of a sample tube in a laboratory) make comparison with the performance standards impossible; neither conformance nor nonconformance with the standards has been shown in these cases. Such situations would include sampling and analysis problems, but not operational problems, which are presumed to be within the control of the owner/operator.

The criteria permit writers should use in accepting two runs as a successful trial burn test are listed below.

a) Only one run contains invalid data. If two or more runs contain invalid data, then the test should be considered inconclusive and should not be used to set operating conditions (i.e., the test should not be considered successful).

b) No data from any run shows failure. For example, if during a trial burn test, one run passes for DRE, one run fails for DRE, and one run has invalid data for DRE, then that test should be considered a failure.

c) The data from the two successful runs should show a reasonable degree of precision and margin of compliance.

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d) There should be no reason to believe (based on operating data, observation of stack emissions, etc.) that the invalid run was less likely to be in compliance than the other two runs. Immediate reporting by the facility of an incident which might invalidate a run (e.g., QA/QC outside of control limits) lends more credence to the claim of invalidity than if the facility waits until all analytical results are in and emission calculations have been made.

e) A detailed written description of the circumstances resulting in the invalidation of data related to any test should be submitted to, and reviewed by, the Agency.

Generally, two valid runs should not be accepted as a successful trial burn test when the owner/operator had direct control over the situation that caused the third run to be invalidated. The trial burn test should be considered unsuccessful if neglect and/or carelessness of either the owner/operator or those conducting the testing/analysis caused the invalidation of a run.

What Constitutes an Unsuccessful Trial Burn

A trial burn is unsuccessful either because it showed a failure to meet the performance standards, or it was inconclusive. A trial burn is considered a failure when enough tests have failed (i.e., show a failure to meet performance standards) such that a full set of operating conditions representing compliance cannot be set in the permit.

A trial burn failure is different from failure of a trial burn test. A test failure shows nonconformance with the standards at one set of operating conditions; however, a facility may still be permitted to operate if it passes one or more trial burn tests at other operating conditions. A trial burn failure occurs when enough tests have failed such that a full set of operating conditions representing compliance cannot be set in the permit. The results of a failed trial burn should not be used to establish final permit operating conditions. Following a failed trial burn, the permitting authority should take one or more of the following actions, as appropriate: 1) take steps to restrict operations (as discussed later in this document); 2) begin processing a denial of the facility's permit application (for an interim status facility); 3) initiate proceedings to terminate the facility's permit (for a new facility); 4) authorize a trial burn retest (also discussed later in this document).

An entire trial burn (like a trial burn test) may be considered inconclusive. An inconclusive trial burn occurs when

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data problems have arisen such that neither conformance nor nonconformance with the performance standards can be shown. The results of an inconclusive trial burn may not be used to establish final permit operating conditions. Following an inconclusive trial burn, the permitting authority should take one or more of the following actions, as appropriate: 1) take steps to restrict operations (as discussed later in this document); 2) begin processing a denial of the facility's permit application (for an interim status facility); 3) initiate proceedings to terminate the facility's permit (for a new facility); 4) authorize a trial burn retest (also discussed later in this document).

Facilities may choose not to test for certain parameters and be permitted at the Tier I or Adjusted Tier I feed rate screening limits established in the BIF rule (56 FR 7134, February 21, 1991), if appropriate. These parameters include metal emissions (40 CFR 266.106), and hydrogen chloride (HCl) and chlorine gas (Cl_2) emissions (40 CFR 266.107). The Tier I and Adjusted Tier I feed rate screening limits are based on the assumption that all metals, HCl, or Cl_2 (depending on the parameter) fed into the system are emitted (i.e., no partitioning into the bottom ash, and no removal by any air pollution control device). This case is the most conservative scenario possible and produces the most stringent feed limits in the permit. The Adjusted Tier I feed rate screening limits also allow for site-specific dispersion modeling. Although directly applicable only to BIFs, these provisions are generally applied to incinerators as well through the Agency's omnibus permitting authority, where necessary to protect human health and the environment.

Facilities that test for these parameters and fail, or show inconclusive results, should not be permitted to operate under the tested conditions. Instead, a permit for the facility (if one is issued) should limit the facility to the Tier I or Adjusted Tier I feed rate screening limits. For example, a permit for a facility that does not meet the HCl or Cl_2 standard when tested under higher chlorine feed rates should limit the chlorine and chloride input to the equivalent of 4 lbs HCl/hr, the Tier I limit, or the Adjusted Tier I limit, as applicable.

Similarly, a permit for a facility that does not meet the metals emissions standards during high temperature testing should limit the metals input into the system to the Tier I or Adjusted Tier I feed rate screening limits (see 56 FR 7171, February 21, 1991).

It should also be noted that, where the trial burn did not demonstrate compliance with the HCl, Cl_2, or metal emissions standards, the permit may specify allowable chlorine or metals feed rates that are more restrictive than the Tier I or Adjusted Tier I limits, based on a site-specific risk assessment which

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considers both direct and indirect exposure pathways to a wide range of pollutants. In this case, the same assumption concerning stack emissions should be applied (that is, the assumption of no partitioning or removal).

How to Handle a Request For a Trial Burn Retest

Facilities that fail or conduct an inconclusive trial burn test or tests may request a retest and submit a revised trial burn plan. The permitting authority would review and approve or deny such a request. For a permitted incinerator or BIF (new or renewal), this request would be processed through the permit modification procedures in accordance with 40 CFR 270.42. The revised trial burn plan can only be approved if 1) it is likely to determine if the performance standards can be met, 2) it does not present an imminent hazard to human health or the environment, and 3) it will help to determine the necessary operating requirements (see 40 CFR 270.62(b)(5) for incinerators and 40 CFR 270.66(d)(2) for BIFs). In the case of a request for a trial burn retest following a trial burn test failure, the applicant should conduct an investigation into the reason for the failure, and make substantive changes in its proposed trial burn plan which would be expected to prevent failure from reoccurring. A facility should not be allowed to retest unless it has made changes to its process (i.e., design and/or operating conditions), that are likely to correct the problems encountered in the failed trial burn test. A facility should not be allowed just to "take its chances" on passing a retest under the same conditions. The first failed test indicates that, at best, the unit would not be in compliance some of the time when operated at those conditions, and that those conditions should therefore not be incorporated into a permit.

As opposed to a trial burn test failure, an inconclusive test would not necessarily require changes to be made to the process prior to allowing a retest. The test could be repeated under the same conditions as the previous test, but with special attention paid to the situation that caused the original test to be inconclusive. During the retest, all attempts should be made to prevent that situation from reoccurring.

There is no set limit on the number of retests allowed under EPA regulations, so long as after each unsuccessful test the above criteria are met and the trial burn plan is revised and approved (through a permit modification for a new incinerator or BIF) prior to any retesting. The same criteria recommended for the design and conduct of initial trial burns are also recommended for all retests (i.e., three runs for each trial burn test, etc.).

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Facilities that wish to conduct a trial burn retest after an unsuccessful test should expeditiously submit a comprehensive request consistent with the guidance discussed above. If a complete request is not promptly submitted, it is appropriate for the Agency to start permit denial proceedings. The Agency's decision to discontinue or delay permit denial proceedings will be highly dependent on the adequacy of any retest request and the Agency's ability assure compliance with applicable regulations during the interim period.

For facilities that fail a trial burn test for only the HCl, Cl_2, particulate, or metal emissions standards, EPA believes it may be appropriate in some cases to authorize a retest for these failed performance standards without simultaneous DRE testing. This decision would depend on the nature of the design or operating modifications made for the retest. If the modifications would not adversely impact DRE (e.g., addition of pollution control equipment), then HCl, particulate, and/or metal tests are sufficient. In this case, operating conditions should be identical to those of the original trial burn test for all parameters other than those related to the modifications which were made. In contrast, if the design or operating modifications made by the facility in order to retest for the HCl, Cl_2, particulate, or metals emissions standards have the potential to affect DRE, then DRE should be retested along with the standards that were not demonstrated.

The permit writer should ensure that operating conditions during a trial burn retest are consistent with the overall scheme of the trial burn plan so that all successful tests can be used in conjunction to establish final operating conditions.

How to Restrict Operations After an Unsuccessful Trial Burn

Permitting authorities should move expeditiously, in appropriate cases, to restrict operations (to the extent that regulatory and statutory authorities allow) after receiving information that a facility conducted an unsuccessful trial burn (i.e., a trial burn failure or an inconclusive trial burn).

Permits for new incinerators and BIFs should be written with a provision that would restrict post-trial burn operations if a facility conducts an unsuccessful trial burn. The Agency recommends that such permits contain the following conditions: 1) the permittee must notify the Regional Administrator within 24 hours of making a determination that the incinerator or BIF failed to achieve any of the performance standards in any run of any test, and 2) upon the request of the Regional Administrator, the permittee shall feed waste and operate the incinerator or BIF only under restricted conditions as specified by the Regional Administrator. (A similar condition is recommended in the

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incinerator module of the model permit, except the second portion of the condition provides that, upon the request of the Regional Administrator, the permittee shall cease feeding hazardous waste to the incinerator. The new recommended language covers the case where a complete shutdown is required, while providing clearer authority in cases where some, but not all, tests were successful.) The permittee then has the option of applying for a permit modification pursuant to 40 CFR 270.42 to conduct a new trial burn pursuant to 40 CFR 270.62(b) for incinerators or 40 CFR 270.66 for BIFs. If an already-issued permit does not have such a provision in it, and the trial burn is unsuccessful, then EPA may still be able to modify the permit to restrict operations based on 40 CFR 270.41(a)(2) or 40 CFR 270.41(b)(1), or terminate the permit based on 40 CFR 270.43(a)(3). The appropriate authorities should be invoked to assure that operations during the post-trial burn period will achieve compliance with the performance standards.

With respect to interim status BIFs, EPA regulations establish certain performance standards that must be met at all times when there is hazardous waste in the unit (40 CFR 266.103(c)(1)). Standards for carbon monoxide, total hydrocarbons, particulate matter, metals emissions, and hydrogen chloride and chlorine gas emissions are included in the regulations. If trial burn data from an interim status BIF indicate failure to comply with any of these standards, then under appropriate circumstances the permitting agency may be able to restrict operations under RCRA Section 3008 or Section 7003.

With respect to interim status incinerators that fail their trial burns, regulatory agencies should either move as quickly as possible to cause the incinerators to cease operations by denying their permits (or, if appropriate, through RCRA Section 7003 actions), or, if appropriate, authorize trial burn retests. This guidance also applies to interim status BIFs that fail their DRE standard during the trial burn, since the DRE standard generally does not apply to BIFs during interim status.

EPA has recently proposed a rule which would provide explicit authority to restrict operations at interim status facilities after a failed or inconclusive trial burn (59 FR 28680, June 2, 1994). During the post-trial burn period, interim status facilities would only be able to operate under conditions that passed and were demonstrated to meet the applicable performance standards, and only if the successful trial burn data are sufficient to set all applicable operating conditions. If finalized as proposed, this regulation would provide additional authority to restrict operations at interim status facilities following a failed or inconclusive trial burn.

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For more background on issues such as permit conditions, trial burn measurements, and validity of data, permit writers may consult the following guidance documents.

- Guidance on Setting Permit Conditions and Reporting Trial Burn Results; January 1989.

- Hazardous Waste Incineration Measurement Guidance Manual; June 1989.

- Quality Assurance/Quality Control (QA/QC) Procedures for Hazardous Waste Incineration, January 1990.

If your staff have any questions on this trial burn failure guidance or how to obtain other guidance materials, they may call Andy O'Palko at (703) 308-8646, or Sonya Sasseville at (703) 308-8648.

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ATTACHMENT B

HOW TO REVIEW A TRIAL BURN REPORT REVIEW CHECKLIST

(46 Sheets)

1.0 OVERVIEW OF TRIAL BURN REPORT REVIEW

The TBR should include the following major elements. These elements are discussed in more detail in the subsections of this component identified below:

- ❑ Executive summary (see Section 3.0)
- ❑ Introduction (see Section 4.0)
- ❑ Process description (see Section 5.0)
- ❑ Testing program overview (see Section 6.0)
- ❑ Test operating conditions (see Section 7.0)
- ❑ Process and stack gas sampling (see Section 8.0)
- ❑ Laboratory procedures (see Section 9.0)
- ❑ Quality assurance/quality control (QA/QC) results (see Section 10.0)
- ❑ Trial burn results summary and proposed permit limits (see Section 11.0)
- ❑ Appendices
    - ❑ TBP and trial burn QAPP (see Sections 12.1 and 12.2)
    - ❑ Stack sampling report (see Section 12.3)
    - ❑ Process sampling report (see Section 12.4)
    - ❑ QA/QC report (see Section 12.5)
    - ❑ Instrument calibration records (see Section 12.6)
    - ❑ Performance calculations (see Section 12.7)
    - ❑ Field logs (see Section 12.8)
    - ❑ Analytical data packages (see Section 12.9)

As discussed in Sections 1.2 and 1.3 of this component, the TBR is typically reviewed by a team of experts. During review of these sections, the TBR review team should check for the following:

- ❑ Verification that the trial burn test was conducted in accordance with the approved TBP and trial burn QAPP
- ❑ Verification that information included as appendices and attachments to the TBR support the data summaries and conclusions presented in the main body of the text
- ❑ Verification that the report draws appropriate conclusions on the basis of information collected during the trial burn test and risk burn test for the following:

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- ❑ Combustion unit operation
- ❑ Appropriate feed rates
- ❑ Representative emission rates
- ❑ Supportable risk assessment results

- ❑ Verification that proposed permit conditions are supported by data summaries

1.1 RECOMMENDED REPORT FORMAT

- ❑ Executive Summary
- ❑ List of key project personnel in the Introduction
- ❑ Whether the TBR format follows the approved TBP
- ❑ Comparison of test conditions to planned conditions
- ❑ Detailed chemical and physical analysis of waste and process samples
- ❑ Stack gas analysis for pollutants as planned, and emission rate calculations for all pollutants
- ❑ QA/QC discussion for all analytical results
- ❑ Whether correct appendices are attached
- ❑ Discussion of problems, delays, or changes from the approved TBP
- ❑ Field data sheets
- ❑ Emission rate calculations
- ❑ Equipment calibration reports
- ❑ Continuous emission monitoring system (CEMS) calibration and performance specification test (PST) results
- ❑ Process data
- ❑ Problems and deviations, especially those affecting QA/QC

1.2 ASSEMBLING THE REVIEW TEAM

For each of the key members listed above, the following information should be evaluated:

- ❑ Team member credentials

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- ❑ Team member availability
- ❑ Team leader assignment
- ❑ Schedule and meeting review
- ❑ Potential conflicts of interest with team members or outside consultants

1.3 DIVIDING THE DOCUMENT

Before meeting with the team, the team leader should check to confirm that all volumes of the TBR have been received. Then, the individual section headings should be checked against the list in Section 1.0 of this component to confirm that all major sections are discussed.

2.0 REVIEWING GENERAL REPORT CONTENTS

- ❑ Table of contents
- ❑ Certification form
- ❑ Appropriate sections (see list in Section 1.3 of this component)
- ❑ Appendices

3.0 REVIEWING THE EXECUTIVE SUMMARY

- ❑ Summary of stack gas parameters and emission rate results (see Section 3.1)
- ❑ Key process system parameters and results (see Section 3.2)
- ❑ Problems encountered during the trial burn test, solutions, and deviations from the approved TBP (see Section 3.3)
- ❑ Conclusions on the success in meeting TBP objectives (see Section 3.4)

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3.1 REVIEWING THE SUMMARY PRESENTATION OF STACK GAS PARAMETERS AND EMISSION RATE RESULTS

The results discussed in the Executive Summary should be verified for accuracy and consistency with the rest of the TBR data and results. At a minimum, check for the following:

- ❑ Whether the stack gas volumetric flow rate, corrected to dry standard conditions, is presented
- ❑ Whether test results represent the average of all runs conducted under a specific test condition
- ❑ Whether carbon monoxide (CO) concentration is reported on the basis of dry parts per million by volume (ppmv), and corrected to 7 percent oxygen (O_2)
- ❑ Whether the POHC DRE is accurate to at least four significant digits (that is, 99.99 percent)
- ❑ Whether all results are presented as numerical values (neither not detectable nor "nondetect" is an acceptable result)
- ❑ Whether the O_2 concentration is reported on the basis of dry units of volume percent
- ❑ Whether the hydrogen chloride (HCl) emission rate is presented in pounds per hour (lb/hr)
- ❑ Whether all pollutants are presented on the basis of dry units
- ❑ Whether the particulate matter (PM) concentration is presented in grains per dry standard cubic feet (gr/dscf) at 7 percent O_2
- ❑ Whether detection limits are reported along with emissions data and identified as to the type of detection limit (for example, practical quantitation limit [PQL] or sample quantitation limit [SQL])
- ❑ Whether emissions data are presented in grams per second (g/sec) for input into the risk assessment
- ❑ Whether any emission rates are adjusted for input into the risk assessment and, if so, justification and data supporting the adjustment (for example, using half the detection limit).

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3.2 REVIEWING THE SUMMARY OF KEY PROCESS SYSTEM PARAMETERS AND RESULTS

- ❑ Whether average, minimum, and maximum combustion zone temperatures are presented
- ❑ Whether waste feed stream and ancillary fuel mass flow rates are presented
- ❑ Whether excess O_2 concentration is presented for all test runs

3.3 REVIEWING THE SUMMARY OF PROBLEMS, SOLUTIONS, AND DEVIATIONS FROM THE TRIAL BURN PLAN

- ❑ Any notation that alternative stack sampling procedures were used
- ❑ Any notation that alternative laboratory procedures were used
- ❑ All deviations from the proposed process operating conditions
- ❑ Reduced performance and efficiency from ancillary equipment or control devices
- ❑ Changes in the targeted POHC

3.4 REVIEWING CONCLUSIONS

- ❑ Whether the POHC DRE was at least 99.99 percent
- ❑ Whether the CO concentration, corrected to 7 percent O_2, was less than 100 ppmv
- ❑ Whether the HCl emission rate was less than or equal to 4 lb/hr and within acceptable risk based limits
- ❑ Whether the PM concentration was less than 0.08 gr/dscf at 7 percent O_2
- ❑ Whether metals emission rates were within the allowable Tier limit and within acceptable risk-based limits
- ❑ Whether organic compound emissions (for example, products of incomplete combustion [PIC] such as PCDDs and PCDFs) were within acceptable risk-based limits
- ❑ Whether emissions met all applicable air permit conditions

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4.0 REVIEWING CHAPTER 1—INTRODUCTION

- ❑ Background information
  - ❑ Facility name
  - ❑ Contact
  - ❑ Address
  - ❑ Telephone number
  - ❑ U.S. EPA identification number
  - ❑ U.S. EPA region
- ❑ Person responsible for TBR
  - ❑ Company name
  - ❑ Address
  - ❑ Telephone number
  - ❑ Date
- ❑ Person responsible for QA/QC
  - ❑ Title
  - ❑ Address
  - ❑ Telephone number
- ❑ Why the test was conducted
- ❑ Person conducting the test and project participants
- ❑ Dates and times of the test

5.0 REVIEWING CHAPTER 2—PROCESS DESCRIPTION

- ❑ Brief process description of the combustion unit
- ❑ Description of auxiliary equipment and unit operations associated with the system (see Component 1—How to Review a Trial Burn Plan, Section 3.0)
- ❑ Design information summary table
- ❑ Summary of process monitors and stack gas analyzers
- ❑ Process diagram showing monitoring points

6.0 REVIEWING CHAPTER 3—TESTING PROGRAM OVERVIEW

- ❑ Trial burn objectives

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- ❑ Planned test program
- ❑ Summary of actual testing performed
- ❑ Deviations from the approved TBP

7.0 REVIEWING CHAPTER 4—TEST OPERATING CONDITIONS

Review the TBR to see whether all operating parameters listed in the TBP are recorded and are within established limits. Check for average, minimum, maximum, and standard deviation of the values collected.

- ❑ Waste and fuel feed rate information (see Section 7.1)
- ❑ Process residuals generation rate and characterization information (see Section 7.2)
- ❑ Stack gas parameter information (see Section 7.3)
- ❑ Fugitive emissions sources and means of control (see Section 7.4)

7.1 REVIEWING WASTE AND FUEL FEED RATE INFORMATION

The instantaneous and hourly rolling averages (HRAs) values for each of the following parameters should be presented for each run of the trial burn test.

- ❑ Maximum organic (high heating value [HHV]) liquid waste feed rate
- ❑ Maximum aqueous (low heating value [LHV]) liquid waste feed rate
- ❑ Maximum containerized waste (that is, container size and type) feed rate
- ❑ Maximum sizes of containerized waste batches
- ❑ Maximum feed rate of each waste type to each combustion chamber
- ❑ Hazardous waste blending procedure, analysis of each waste before blending, and blending ratio (only if more than one hazardous waste stream is blended)
- ❑ Review the data logsheets (units, rate) to assure that the results presented are accurate and consistent
- ❑ Solid waste feed rate
- ❑ Auxiliary fuel feed rate

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If the facility is reporting the results of a risk burn, additional data should be provided. These data may include the following:

- ❑ Average hazardous waste feed rate (each stream) for each risk burn run
- ❑ Minimum and maximum hazardous waste feed rate (each stream) for each risk burn run
- ❑ Supporting data regarding normal operating conditions (may also be submitted as part of the RBP)

7.2 REVIEWING WASTE GENERATION RATE INFORMATION

- ❑ Ash, process effluents, and solids residuals identification
- ❑ Sampling method
- ❑ Sampling frequency (every 15 minutes and 1 hour composite)
- ❑ Sampling duration (minimum 1 hour sampling time per run)
- ❑ Sampling location
- ❑ Ash, process effluents, and residual generation rate
- ❑ Ash, process effluents, and residual analytical data

7.3 REVIEWING STACK GAS PARAMETER INFORMATION

- ❑ CO emission levels, in ppmv, corrected to 7 percent O_2 (see Section 7.3.1)
- ❑ Stack gas flow rate and velocity at actual, dry standard, and 7 percent O_2 conditions (see Section 7.3.2)
- ❑ O_2 levels in volume percent (see Section 7.3.3)
- ❑ Inlet gas temperature to the dry APCS (see Section 7.3.4)
- ❑ Combustion unit temperature (see Section 7.3.5)
- ❑ APCS control parameters (see Section 7.3.6)

7.3.1 Verifying Stack Gas Carbon Monoxide

- ❑ CEMS CO concentration during the trial burn in ppmv (minimum of three runs per test condition) corrected to 7 percent O_2.

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The following values should be provided for each run of the trial burn test:

- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ CEMS CO strip chart and original log recorded during testing

❑ If dual CO CEMS are installed, confirm which monitor corresponds with which strip chart or data set.

Generally, the permit target value for CO emissions is 100 ppmv, corrected to 7 percent O_2.

7.3.2 Verifying Stack Gas Flow Rate

❑ Stack gas flow rate and velocity (minimum of three runs per test condition)

The following values should be provided for each run of the trial burn test:

- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ Location of stack gas flow rate measurement

❑ Whether stack gas flow rate is within limits of the TBP target and, if not, an explanation for being outside the limits

❑ Stack gas flow rate and velocity calculations, including water (H_2O), O_2, nitrogen (N_2), carbon dioxide (CO_2), and CO levels in the flue gas

❑ Stack gas flow rate values for actual, dry standard, and 7 percent O_2 conditions.

❑ Whether reported values are consistent with test operating data

7.3.3 Verifying Stack Gas Oxygen Concentration

❑ O_2 concentration in the flue gas during the trial burn (minimum of three runs per test condition, on a dry-gas basis

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The following values should be provided for each run of the trial burn test:

- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ CEM O_2 strip chart and original log recorded during the testing

❑ Whether O_2 levels during testing are within the limits of the trial burn target and, if not, whether excursions beyond the limits are explained

7.3.4 Verifying Dry Air Pollution Control Equipment Inlet Gas Temperature

❑ Inlet gas temperature to the APCE during the trial burn test (minimum of three runs per test condition)

The following values should be provided for each run of the trial burn test:

- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ Continuous temperature strip chart or digital data recorded during the testing

7.3.5 Verifying Combustion Unit Temperature

❑ Combustion unit temperature during the trial burn (minimum of three runs per test condition)

The following values should be provided for each run of the trial burn test:

- ❑ Minimum and maximum instantaneous concentrations
- ❑ Minimum and maximum HRA concentrations
- ❑ Standard deviation of instantaneous and HRA values
- ❑ Average instantaneous and HRA values for all runs at each test condition

❑ Continuous temperature strip chart recorded during testing

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- ❑ If dual thermocouples are installed, confirm which instrument corresponds to which strip chart or data set

- ❑ Whether trial burn temperatures are near target values established in the TBP

- ❑ Verify all calculated values presented in the TBR

7.3.6 Verifying the Air Pollution Control System Control Parameters

Based on the type of APCS used, various control parameters must be recorded during the trial burn test and reported in the TBR. Important control parameters may include:

- ❑ Baghouse and fabric filter
  - ❑ Inlet gas temperature
  - ❑ Pressure drop
  - ❑ Flue gas flow rate
  - ❑ Air-to-cloth ratio

- ❑ Electrostatic precipitator
  - ❑ Inlet gas temperature
  - ❑ Direct current voltage
  - ❑ Flue gas flow rate

- ❑ Venturi Scrubber
  - ❑ Inlet gas temperature
  - ❑ Pressure drop
  - ❑ Liquid flow rate
  - ❑ Liquid to flue gas ratio
  - ❑ Maximum suspended solids
  - ❑ pH (if used for acid gas removal)

The reviewer should check to ensure that continuous data for each applicable control parameter are included in the TBR. The reviewer should also verify all calculated values.

7.4 REVIEWING FUGITIVE EMISSIONS SOURCES AND MEANS OF CONTROL

- ❑ The existence of a fugitive emissions control system

- ❑ Whether fugitive emission controls include the following:
  - ❑ Sealed combustion zone
  - ❑ Combustion zone pressure lower than atmospheric

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- ❑ Alternative fugitive emissions control scheme of periodic monitoring used for systems operating at pressures higher than atmospheric

8.0 REVIEWING CHAPTER 5—PROCESS AND STACK GAS SAMPLING

- ❑ Sampling locations and methods (see Section 8.1)
- ❑ Waste and fuel feed sampling (see Section 8.2)
- ❑ Process residuals sampling (see Section 8.3)
- ❑ Stack gas sampling procedures (see Section 8.4)

8.1 REVIEWING SUMMARY OF SAMPLING LOCATIONS AND METHODS

- ❑ Liquid waste feed sampling location and method
- ❑ Solid waste feed sampling location and method
- ❑ Auxiliary fuel feed sampling location and method
- ❑ Gaseous waste feed sampling location and method

8.2 REVIEWING SUMMARY OF WASTE AND FUEL FEED SAMPLING

- ❑ Whether all hazardous waste feed streams are sampled
- ❑ Whether all auxiliary waste feed streams are sampled
- ❑ Whether all solid waste feed streams are sampled
- ❑ Parameters analyzed (such as moisture, density, ash, viscosity, heating value, and halides)
- ❑ Sampling method
- ❑ Sampling frequency (liquid waste: one every 15 minutes; solid waste: one every 15 minutes for bulk solid waste, one representative grab sample for containerized solid waste; auxiliary fuel feed: one per run)
- ❑ Composite sampling method used if different waste streams are involved
- ❑ Sampling location
- ❑ Sampling duration (minimum 1 hour per run)

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The following subsections further describe how to review the following information:

- ❑ POHC feed rate (see Section 8.3.1)
- ❑ Ash feed rate (see Section 8.3.2)
- ❑ Cl_2 feed rate (see Section 8.3.3)
- ❑ Hazardous metal feed rate (see Section 8.3.4)
- ❑ Combustion unit heat input rate (see Section 8.3.5)

8.2.1 Verifying Principal Organic Hazardous Constituent Feed Rate

- ❑ Type of POHC measured in each waste during the trial burn
- ❑ POHC feed rate of each waste during the trial burn
- ❑ POHC mass rate calculations in the appendix of the report

8.2.2 Verifying Ash Feed Rate

- ❑ Ash concentration in each feed stream
- ❑ Flow rate of each stream containing ash
- ❑ Ash feed rate calculations in the appendix of the report

8.2.3 Verifying Chlorine Feed Rate

- ❑ Cl_2 concentration and flow rate of each waste stream containing Cl_2
- ❑ Cl_2 feed rate calculations in the appendix of the report
- ❑ Methods used to analyze for Cl_2

8.2.4 Verifying Hazardous Metal Feed Rate

- ❑ Feed rate of each of the 10 BIF-regulated metals: antimony; barium; lead; mercury; silver; thallium; arsenic; beryllium; cadmium; and chromium; plus non-BIF-regulated metals: nickel; and selenium
- ❑ Total feed stream input rate
- ❑ Total hazardous waste feed stream input rate
- ❑ Total pumpable hazardous waste feed stream input rate

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- ❑ Methods used to analyze metals
- ❑ Calculations based on feed rate and metals concentration

8.2.5 Verifying Combustion Unit Heat Input Rate

- ❑ Individual waste stream heat input rate
- ❑ Auxiliary fuel stream heat input rate
- ❑ Total heat input rate

8.3 REVIEWING SUMMARY OF AIR POLLUTION CONTROL SYSTEM GENERATED WASTE

- ❑ Process residual sampling location and sampling frequency
- ❑ Constituent/concentrations in each sample
- ❑ Sample compositing techniques
- ❑ Discussion of results compared to system performance

8.4 REVIEWING STACK GAS SAMPLING SUMMARY

The following subsections describe various aspects of stack gas sampling:

- ❑ Sampling and analysis of stack gas during the trial burn test for determination of specified parameters (see Section 8.4.1)
- ❑ Data tables for stack gas characteristics (see Section 8.4.2)
- ❑ Data tables for emission rates of constitutents of potential concern (see Section 8.4.3)

8.4.1 Reviewing Summary of Stack Gas Sampling Methods

The reviewer should determine which methods were used for the indicated parameter. Examples include:

- ❑ 40 CFR Part 60, Appendix A, Method 1—Traverse Points (see Section 8.4.1.1)
- ❑ 40 CFR Part 60, Appendix A, Method 2—Velocity and Flow Rate (see Section 8.4.1.2)
- ❑ 40 CFR Part 60, Appendix A, Method 3—CO_2, O_2, Excess Air, Molecular Weight (see Section 8.4.1.3)

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- ❑ 40 CFR Part 60, Appendix A, Method 4—Moisture Content (see Section 8.4.1.4)
- ❑ 40 CFR Part 60, Appendix A, Method 5, or Test Methods for Evaluating Solid Waste, SW-846 Method 0050—PM (see Section 8.4.1.5)
- ❑ Appendix IX to 40 CFR Part 266 or SW-846, Method 0050 or Method 0051—HCl and Cl_2 (see Section 8.4.1.5)
- ❑ Test Methods for Evaluating Solid Waste: SW-846 Method 0030 or SW-846 Method 0031—Volatile Organic Compounds (VOC) (see Section 8.4.1.6)
- ❑ Test Methods for Evaluating Solid Waste; SW-846 Method 0010—Semivolatile Organic Compounds (SVOC) (see Section 8.4.1.7)
- ❑ 40 CFR Part 266, Appendix IX or SW-846, Method 23, or SW-846 Method 23A—PCDD/PCDF (see Section 8.4.1.8)
- ❑ 40 CFR Part 266, Appendix IX, Section 3.1, Method 0012, or SW-846 Method 0060—Metals (see Section 8.4.1.9)
- ❑ 40 CFR Part 266, Appendix IX, Section 3.2, Method 0013, or SW-846 Method 0061—Hexavalent Chromium (see Section 8.4.1.10)
- ❑ 40 CFRPart 266, Appendix IV, Section 3.5, or SW-846 Method 0011—Aldehydes and Ketones (see Section 8.4.1.11)
- ❑ SW-846 Method 0040—Organic Constituents from Combustion Sources using Tedlar® Bags (see Section 8.4.1.12)

Note that Methods 0010 and 0040 are used to collect samples for the measurement of unspeciated total organics (TO). Additionally, Methods 0010 and 23 or 0023A may be combined—additional guidance of these procedures are described in Component 4—How to Conduct Trial Burn Test Oversight.

8.4.1.1 Verifying Traverse Points

- ❑ Stack and duct diameter or dimensions
- ❑ Numbers of traverse points selected for PM and velocity traverses (based on stack dimensions, location of sampling ports, and upstream and downstream disturbance)
- ❑ Absence of cyclonic flow

8.4.1.2 Verifying Stack Gas Velocity and Flow Determination

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- ❑ Type of pitot tube
- ❑ Pitot tube coefficient
- ❑ Data sheet for velocity traverse (for each traverse point there should be a measurement of the velocity head and stack temperature)
- ❑ Sampling time (minimum of 2 hours for a composite sample per run)
- ❑ Calculation of stack gas velocity under (1) actual and standard temperature and pressure (STP) conditions, and (2) corrected to 7 percent O_2
- ❑ Calculation of stack gas flow rate under (1) actual and STP conditions, and (2) corrected to 7 percent O_2

8.4.1.3 Verifying Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Molecular Weight

- ❑ Sampling method
- ❑ Gas analysis method (Orsat or Fyrite)
- ❑ Sampling time (minimum of 2 hours for composite sample per run)
- ❑ Percent of CO, CO_2, and O_2
- ❑ Molecular-weight calculations for each run

8.4.1.4 Verifying Method of Determining Moisture in Stack Gas

- ❑ Field data sheets (for each traverse point, record sampling time stack temperature, orifice meter differential (Δ H); meter reading for gas volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger])
- ❑ Sampling time (minimum of 2 hours per composite sample per run)
- ❑ Moisture calculations

8.4.1.5 Verifying Method of Determining Particulates, Hydrogen Chloride, and Chlorine

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]). Ensure data are collected at consistent interval throughout run—for example, every 5 minutes.

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- ❑ Sampling train arrangement, as suggested in U.S. EPA Methods 0050 and 0051
- ❑ Proper temperature maintenance (probe and filter at 248 ± 25°F, train exit gas less than 68°F)
- ❑ Sampling time (minimum of 2 hours per composite sample per run)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.1.6 Verifying Volatile Organic Sampling Train Sampling Method for Determination of Volatile Organics

- ❑ Field data sheet showing sample volume and sampling duration (see Section IV of U.S. EPA 1989 Checklist for Reviewing RCRA TBRs for more details)
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0030 or U.S. EPA Method 0031
- ❑ Minimum sampling time of 2 hours or 20 to 40 minutes per set of VOST cartridges, with three to four sets VOST cartridges per run (typically, four sets are collected, and three are analyzed; with one set saved as a back up)
- ❑ Calculations showing sample volumes corrected to standard conditions
- ❑ Whether the samples were analyzed for the target VOC list identified in the TBP (the VOC analyte list should include, at a minimum, all target analytes for SW-846 U.S. EPA Method 3542)
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.1.7 Verifying Semivolatile Organic Sampling Train Sampling Method for Determination of Semivolatile Organics

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0010

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- ❑ Maintenance of proper sampling train temperatures
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Minimum sampling time of 2 hours per run
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

See Section IV of the U.S. EPA 1989 Checklist for Reviewing RCRA TBRs for more details.

8.4.1.8 Verifying Sampling Method for Polychlorinated Dibenzopdioxin/Polychlorinated Dibenzofuran

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condensor [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Methods 23 and 0023A
- ❑ Maintenance of probe exit temperature and filter compartment at 248 ± 25°F during sampling
- ❑ Whether gas enters sorbent tube module at or below 68°F
- ❑ Minimum sampling time of 3 hours per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ PCDD/PCDF emission calculations
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.1.9 Verifying Sampling Method for Multiple Metals

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in referenced method

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- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Minimum sampling time of about 3 hours composite per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Metals emission rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

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8.4.1.10 Verifying Sampling Method for Hexavalent Chromium

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in referenced method
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Minimum sampling time of about 3 hours per run
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Hexavalent chromium emission rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.1.11 Verifying Sampling Method for Aldehydes and Ketones

- ❑ Field data sheets (for each traverse point, record sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger]).
- ❑ Sampling train configuration, as suggested in U.S. EPA Method 0011
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Minimum sampling time of 2 hours per run
- ❑ Stack flow rate calculations
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.1.12 Verifying Sampling Method for Organic Constituents Using Tedlar® Bags

- ❑ Field data sheets (stack gas velocity head, stack gas temperature, condition temperatures)

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- ❑ Sampling train configuration, as outlined in Method 0040
- ❑ Constant sampling rate
- ❑ Minimum sample time of 60 minutes
- ❑ Consistency with observations documented in the trial burn oversight report

8.4.2 Reviewing Data Tables For Stack Gas Characteristics

- ❑ Summary table for each isokinetic sampling train, including sampling time, corrected sample volume, stack gas temperature, moisture content, CO_2 percent, O_2 percent, stack gas velocity, stack gas flow rate, and percent isokinetic achieved
- ❑ Summary table for VOST including actual volume sampled, through the sampling train, average meter temperature, and corrected volume

8.4.3 Reviewing Data Tables for Emission Rates of Constituents of Potential Concern

This information may be collected during trial burn or risk burn test conditions. The TBR should clearly indicate the basis for the emission rates

- ❑ Summary tables calculated for COPC emission rates (average, minimum, and maximum), standard deviation, and 95th percentile values for:
  - ❑ Hexavalent chromium
  - ❑ VOCs
  - ❑ SVOCs
  - ❑ PCDD/PCDF
  - ❑ Metals
  - ❑ PAHs
  - ❑ Aldehydes and ketones
  - ❑ HC1/Cl2
  - ❑ PM

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9.0 REVIEWING CHAPTER 6—LABORATORY PROCEDURES

- ❑ Reference to the approved TBP and approved QAPP
- ❑ Laboratory QA/QC performance checks
- ❑ Whether all proposed samples were collected
- ❑ Whether all proposed analytical parameters were conducted
- ❑ Any deviations from the approved TBP or QAPP
- ❑ Any problems with sampling analysis or QA/QC checks

9.1 REVIEWING THE SUMMARY OF ON-SITE ANALYTICAL PROCEDURES

- ❑ Reference to approved TBP and QAPP
- ❑ Reference to on-site analysis conducted by the facility
- ❑ Reference to on-site analysis conducted by the sampling contractor
- ❑ Discussion of QA/QC checks conducted by the on-site laboratory
- ❑ Discussions of any deviations from approved TBP or QAPP

9.2 REVIEWING THE SUMMARY OF OFF-SITE ANALYTICAL PROCEDURES

- ❑ Reference to the approved TBP and QAPP
- ❑ Identification of off-site laboratory and analyses conducted
- ❑ Presentation of completed COC forms
- ❑ Discussion of any deviations from approved TBP or QAPP
- ❑ Discussion of QA/QC checks conducted by off-site laboratory

10.0 REVIEWING CHAPTER 7—QUALITY ASSURANCE/QUALITY CONTROL RESULTS

- ❑ Reference to the approved QAPP
- ❑ Assessment of data quality
- ❑ Discussion of out-of-specification data and QA/QC procedure deviations
- ❑ Listing of equipment calibration frequency

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- ❑ Identification of QA/QC objectives, procedures, and results
- ❑ Presentation of data analysis and validation procedures

10.1 REVIEWING THE SUMMARY OF ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RESULTS

- ❑ Reference to approved TBP and QAPP
- ❑ Documentation of QA/QC activity
- ❑ Discussion of any deviations from approved procedures

10.1.1 Stack Gas Samples

- ❑ U.S. EPA Method 1—Sample and Velocity Traverses
  - ❑ Stack/duct diameter or dimensions
  - ❑ Circular/rectangular
  - ❑ Location of sampling ports
  - ❑ Upstream/downstream disturbance
  - ❑ Number of traverse points
  - ❑ Absence of cyclonic flow
- ❑ U.S. EPA Method 2—Stack Gas Velocity and Flow Rate Determination
  - ❑ Type of pitot tube
  - ❑ Data sheet velocity traverse
  - ❑ Pitot tube coefficient
  - ❑ Pitot tube inspection - documentation and date
  - ❑ Calculation of average stack gas velocity
  - ❑ Calculation of stack gas flow rate
  - ❑ Thermocouple calibration range and date
  - ❑ Barometer calibration date
  - ❑ QC procedures
- ❑ U.S. EPA Method 3—Gas Analysis for CO_2, O_2, Excess Air, and Molecular Weight
  - ❑ Sampling method—single point/multiple point, grab/integrated sampling
  - ❑ Gas analysis method—Orsat or Fyrite analyzer (U.S. EPA Method 3) or continuous monitors (U.S. EPA Method 3A)
  - ❑ Field data sheet
  - ❑ Molecular weight calculation
  - ❑ Excess air calculation
  - ❑ Leak check for sampling/analyzer
  - ❑ QC procedures

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- ❑ U.S. EPA Method 4—Determination of Moisture in Stack Gases

  - ❑ Calibration sheets
  - ❑ Field data sheets
  - ❑ Constant sampling rate
  - ❑ Proper sampling rate
  - ❑ Stack properly traversed
  - ❑ Train temperature maintained below 68°F
  - ❑ Pump/train leak checked
  - ❑ Weight of moisture determined

- ❑ U.S. EPA Method 5/SW-846 U.S. EPA Method 0050 or U.S. EPA Method 0051—Particulate, HCl/Cl_2

  - ❑ Calibration sheets
  - ❑ Field data sheets
  - ❑ Isokinetic calculations
  - ❑ Maintenance of proper temperatures
  - ❑ Sampling rate
  - ❑ Leak checks
  - ❑ Sample recovery documentation
  - ❑ Probe rinse procedures
  - ❑ Handling/distribution of samples for analysis

- ❑ U.S. EPA Modified Method 5/SW-846 U.S. EPA Method 0010—Semivolatile Organics

  - ❑ Calibration sheets
  - ❑ Field data sheets
  - ❑ Isokinetic calculations
  - ❑ Maintenance of proper temperatures
  - ❑ Sampling rate
  - ❑ Leak checks
  - ❑ Sample recovery documentation for XAD resin
  - ❑ Sample recovery documentation
  - ❑ Probe rinse procedures
  - ❑ Handling/distribution of samples for analysis
  - ❑ Sample recovery documentation for blank sample collection
  - ❑ GC/flame ionization detector (FID) for unspeciated semivolatile organics
  - ❑ Gravimetric analysis (GRAV) for non-volatile compoundss

- ❑ U.S. EPA U.S. EPA Method 0012/SW-846 U.S. EPA Method 0060—Multiple Metals

  - ❑ Calibration sheets
  - ❑ Field data sheets

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- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Impinger solutions 1, 2, and 3 collected in a prelabeled sample bottle
- ❑ Impinger 4 liquid collected in an amber glass sample bottle
- ❑ Impinger solutions 5 and 6 collected in an amber glass bottle with a Teflon-lined lid
- ❑ Visual inspections conducted

❑ U.S. EPA U.S. EPA Method 0013/SW-846 U.S. EPA Method 0061—Hexavalent Chromium

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation
- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Absorbing liquid continuously recirculated from first impinger through the sample line
- ❑ Probe maintained at a temperature below 200°F throughout sampling
- ❑ Probe ends capped before removing to recovery area
- ❑ pH of impinger 1 above 8.5
- ❑ Nitrogen bubbled through impinger train at 10 liters/minute for 30 minutes
- ❑ Liquid in impingers 1, 2, 3, and 4 weighed and placed in an amber glass sample bottle
- ❑ Contents of container 3 filtered

❑ U.S. EPA U.S. EPA Method 0023/SW-846 U.S. EPA Method 0023A—PCDD/PCDF Sampling

- ❑ Calibration sheets
- ❑ Field data sheets
- ❑ Isokinetic calculations
- ❑ Maintenance of proper temperatures
- ❑ Sampling rate
- ❑ Leak checks
- ❑ Sample recovery documentation

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- ❑ Probe rinse procedures
- ❑ Handling/distribution of samples for analysis
- ❑ Nozzle sealed after being removed from the stack

❑ U.S. EPA Methods 0030 and 0031—Volatile Organic Sampling Train (VOST)

- ❑ Calibration sheets
- ❑ Sample volume
- ❑ Sampling duration
- ❑ Number of trap pairs per test run
- ❑ Leak checks for each run or trap pair
- ❑ Blank traps taken
- ❑ Field data log/documentation for each pair
- ❑ Trap storage and shipment

❑ U.S. EPA U.S. EPA Method 0040—Total Volatile Organics

- ❑ Field GC for volatiles

❑ U.S. EPA Method 7E—Determination of Nitrogen Oxides Emissions from Stationary Sources

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds

❑ U.S. EPA Method 10—Determination of Carbon Monoxide Emissions from Stationary Sources

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds
- ❑ Instrument measurement range
- ❑ Performance specification test results

❑ U.S. EPA Method 25A—Determination of Total Gaseous Nonmethane Organic Emissions Using a Flame Ionization Analyzer

- ❑ Leak check
- ❑ Proper calibration gas with certificate of analysis
- ❑ Record of calibration results
- ❑ Zero span and calibration draft test
- ❑ Data logged every 60 seconds

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- ❑ Instrument measurement range
- ❑ Performance specification test results

❑ CO and O_2 CEMS

- ❑ Verification of absence of leakage at CO and O_2 sampling location
- ❑ Calibration gas concentration (zero and high-level)
- ❑ Calibration gas certificate (confirm that CO protocol calibration gases have not expired)
- ❑ Calibration checks before each run and daily
- ❑ Zero and span calibration drift test during trial burn
- ❑ Sampling and analysis conducted every 15 seconds during trial burn
- ❑ Data logged every 60 seconds during trial burn

10.1.2 Process Samples

❑ Identification of all process samples collected

❑ Identification of all QA/QC samples collected

❑ Sample frequency

❑ Sample volume

❑ Sample container and storage conditions

❑ Sample method

❑ Sample traceability procedures

❑ Any special sample preparation requirements

10.2 REVIEWING THE SUMMARY OF OFF-SITE QUALITY ASSURANCE/QUALITY CONTROL RESULTS

❑ Sample traceability

❑ Holding times

❑ Feedstocks, fuel, and APCS residual sample analytical results

❑ Stack gas sample analytical results

❑ QC assessment

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- ❑ QA coordinator report

11.0 REVIEWING CHAPTER 8—TRIAL BURN RESULTS SUMMARY AND PROPOSED PERMIT LIMITS

This chapter should include subsections on the following topics:

- ❑ Destruction and removal efficiencies (see Section 11.1)
- ❑ CEMS results (see Section 11.2)
- ❑ Stack gas emission rate results (see Section 11.3)
- ❑ Proposed process limits (see Section 11.4)
- ❑ Proposed waste feed limits (see Section 11.5)
- ❑ Proposed automatic waste feed cutoff limits (see Section 11.6)
- ❑ Proposed data for use in the risk assessment (see Section 11.7)

While reviewing these sections of the TBR, the review team should check for the following:

- ❑ Emission rate results summary for each run
  - ❑ DRE for each POHC (DRE test condition)
  - ❑ PCDD/PCDF emission rates (risk burn test condition)
  - ❑ Metals emissions rates (high temperature and risk burn test conditions)
  - ❑ Hexavalent chromium emission rate (high temperature and risk burn test conditions)
  - ❑ HCl/Cl_2 emission rates (all test conditions)
  - ❑ CO concentration levels in flue gas (all test conditions)
  - ❑ VOC and SVOC emission rates (DRE and risk burn test conditions)
  - ❑ Particle size distribution (PSD) (risk burn test condition)
  - ❑ TO emission rates for volatile, semivolatile, and GRAV fractions (risk burn test condition)
- ❑ Summary of the key trial burn operating conditions (these data should include the following values for each run: minimum, maximum, average, standard deviations, average HRAs, minimum HRAs, and maximum HRAs)
  - ❑ Liquid waste feed rate
  - ❑ Combustion chamber temperature
  - ❑ Baghouse (or APCS) inlet temperature

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- ❑ Stack gas O_2 concentration
- ❑ Ash feed rate
- ❑ Chloride feed rate
- ❑ Metals feed rate
- ❑ Baghouse differential pressure
- ❑ Combustion gas velocity
- ❑ Auxilliary fuel feed rate
- ❑ Other APCS key parameters

❑ Proposed permit limits

- ❑ Maximum waste feed rate
- ❑ Minimum and maximum combustion gas temperature
- ❑ Maximum combustion gas flow rate
- ❑ Minimum and maximum production rate
- ❑ Minimum stack gas O_2 concentration
- ❑ Maximum baghouse inlet temperature
- ❑ Minimum baghouse differential pressure
- ❑ Maximum ash feed rate
- ❑ Maximum chloride rate
- ❑ Maximum BIF metals rate
- ❑ Auxilliary fuel feed rates
- ❑ Total pumpable waste feed rate
- ❑ APCS parameters

Sections 11.1 through 11.7 of this component provide more detailed information for the parameters included under this "Check For" section.

11.1 REVIEWING DESTRUCTION AND REMOVAL EFFICIENCIES

❑ DRE of at least 99.99 percent for each POHC (during each run of the DRE test condition) identified in the trial burn

❑ DRE calculations, including POHC feed rate and POHC stack gas emissions rate

11.2 REVIEWING CONTINUOUS EMISSION MONITORING SYSTEM RESULTS

❑ Whether CO concentration, during testing (for each run, all test conditions), corrected to 7 percent O_2, is below 100 ppmv

11.3 REVIEWING STACK GAS EMISSION RATE RESULTS

This chapter of the TBR should include subsections regarding the following topics:

❑ PM and PSD results for each run (see Section 11.3.1)

❑ HCl and Cl_2 emission rate results for each run (see Section 11.3.2)

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- ❑ Metals emission rate results for each run (see Section 11.3.3)
- ❑ POHC emission rate results for each run (see Section 11.3.4)
- ❑ PIC emission rate results for each run (see Section 11.3.5)
- ❑ TO emission rate results for each run (see Section 11.3.6)
- ❑ PCDD/PCDF emission rate results for each run (see Section 11.3.7)

This section discusses how to review the emission rate results for each of these compounds. Sections 11.3.1 through 11.3.7 of this component include example sections for each of the emission parameters

11.3.1 Reviewing Particulate Matter Emission Rate Results

- ❑ Whether emission rate is less than 180 μg/dscm (0.08 gr/dscf)
- ❑ PM emission calculations
- ❑ Whether isokinetic sampling results are acceptable (within 90 to 110 percent)
- ❑ Appropriate correction for soot blowing

11.3.2 Reviewing Hydrogen Chloride and Chlorine Gas Emission Rate Results

- ❑ Trial burn HCl and Cl_2 emission rates (use field data and laboratory results to see whether TBP objectives were met)
- ❑ HCl and Cl_2 emission rate calculations

11.3.3 Reviewing Metal Emission Rate Results

- ❑ Trial burn results for metal emissions to see whether TBP objectives were met
- ❑ Metal emissions calculations

11.3.4 Reviewing POHC Emission Rate Results

- ❑ Trial burn results of POHC emissions to see whether TBP objectives are met
- ❑ POHC stack gas emission calculations (check field data logsheets and analytical report)

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Section 11.1 of this component presents POHC (benzene) emission rate sample calculations. To calculate POHC in ash and residue, multiply the POHC concentration in the ash and residue by the ash and residue generation rate, respectively.

11.3.5 Reviewing PIC Emission Rate Results

- ❑ VOC PICs emission rate based on VOST results (U.S. EPA Methods 0030 and 0031)
- ❑ SVOC PICs emission rate based on SVOST results (sampling U.S. EPA Method 0010, analytical U.S. EPA Method 8270)

11.3.6 Reviewing Total Organic Emission Rate Results

- ❑ Volatile organics emission rate of compounds determined using U.S. EPA Method 0040 (SW-846)
- ❑ Semiovolatile organics emission rate of compounds determined using U.S. EPA Method 0010 (SW-846)
- ❑ Nonvolatile organics emission rate of compounds determined using U.S. EPA Method 0010 (SW-846)

11.3.7 Reviewing Polychlorinated Dibenzopdioxin/Polychlorinated Dibenzofuran Emission Rate Results

- ❑ Trial burn results of PCDD/PCDF emissions
- ❑ PCDD/PCDF emission calculations
- ❑ DRE of 99.9999 percent for PCDD/PCDFs

11.4 REVIEWING PROPOSED PROCESS LIMITS

- ❑ Maximum (average during test run) emission rate of each metal
- ❑ Feed rate of metals in each hazardous waste stream
- ❑ Total feed rate of Cl_2 and HCl in total feed streams
- ❑ Fuel feed rates
- ❑ Maximum combustion gas temperature
- ❑ Minimum combustion gas temperature
- ❑ Maximum flue gas temperature at the inlet to the PM control device

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- ❑ Combustion gas velocity
- ❑ Maximum device production rate
- ❑ Minimum device production rate
- ❑ APCS parameters

Subsections that follow contain procedures for reviewing proposed waste feed limits, AWFCO limits, combustion unit parameters, and APCS parameters. Sections 11.5, 11.6, 11.6.1, 11.6.2, and 11.6.2.1 through 11.6.2.6 of this component include the example comments for review of key process limits.

11.5 REVIEWING PROPOSED WASTE FEED LIMITS

- ❑ Whether waste feed rate is the proposed permit limit set at maximum feed rate (review feed rate data of trial burn)
- ❑ Whether the proposed permit limit is established as a single, 1-hour rolling average

11.6 REVIEWING PROPOSED AUTOMATIC WASTE FEED CUTOFF LIMITS

This chapter of the TBR should include subsections that address:

- ❑ Combustion unit parameters (see Section 11.6.1)
- ❑ APCS parameters (see Section 11.6.2)
- ❑ Parameters for other associated equipment (see Section 11.6.3)

During review of these subsections, the TBR review team should check for the following:

- ❑ AWFCO limits
- ❑ Whether AWFCO limits are established for the parameters listed above

11.6.1 Reviewing Parameters for Combustion Units

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- ❑ Whether the proposed permit limit for combustion gas velocity is set at the maximum combustion gas velocity (review gas velocity data during the appropriate test conditions of the trial burn)

- ❑ Whether proposed permit limits for combustion chamber temperature are set at minimum and maximum combustion unit temperatures measured during the appropriate test conditions of the trial burn

- ❑ Whether the proposed permit limits are established as both instantaneous and HRA

11.6.2 Parameters for Reviewing Air Pollution Control Systems

The following subsections should be included (if applicable to the APCS employed):

- ❑ Dry scrubber parameters (see Section 11.6.2.1)

- ❑ Wet ionizing scrubber parameters (see Section 11.6.2.2)

- ❑ Venturi scrubber parameters (see Section 11.6.2.3)

- ❑ Wet scrubber parameters (see Section 11.6.2.4)

- ❑ Electrostatic precipitator parameters (see Section 11.6.2.5)

- ❑ Baghouse (fabric filter) parameters (see Section 11.6.2.6)

- ❑ Other associated equipment parameters (see Section 11.6.3)

The following items should be evaluated by the TBR review team:

- ❑ Proposed permit limits for APCS parameters

- ❑ Trial burn monitoring data for APCS parameters to confirm that proposed permit limits reflect actual APCS monitoring parameters

- ❑ Whether proposed permit limits for APCS parameters are established as HRAs

11.6.2.1 Reviewing Dry Scrubber Parameters

- ❑ Minimum average caustic feed rate

- ❑ Maximum average flue gas flow rate

11.6.2.2 Reviewing Parameters For Wet Ionizing Scrubber

- ❑ Minimum average liquid to gas ratio

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- ❑ Minimum average scrubber blowdown from the system or maximum suspended solids content of scrubber water
- ❑ Minimum average pH level of the scrubber
- ❑ Minimum average electric power, in kilovolt amperes (kVA) or applied voltage, to precipitator plates
- ❑ Maximum average flue gas flow rate

11.6.2.3 Reviewing Venturi Scrubber Parameters

- ❑ Minimum average differential gas pressure limit across the venturi scrubber (the differential pressure is measured by applying pressure taps on each side of the venturi, connected to a differential pressure [$\triangle$P] transducer)
- ❑ Minimum average liquid-to-gas ratio limit
- ❑ pH level limit
- ❑ Maximum total suspended solids
- ❑ Minimum APCS inlet temperature (dry units)

11.6.2.4 Reviewing Wet Scrubber Parameters

- ❑ Minimum average liquid-to-gas ratio limit
- ❑ Maximum average flue gas flow rate limit
- ❑ pH level limits for scrubber effluent
- ❑ Maximum average inlet temperature
- ❑ Maximum total suspended solids

11.6.2.5 Reviewing Parameters For Electrostatic Precipitators

- ❑ Minimum electric power, in kVA or applied voltage, to precipitator plates
- ❑ Maximum average flue gas flow rate
- ❑ Maximum average inlet temperature

11.6.2.6 Reviewing Baghouse (Fabric Filter) Parameters

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- ❑ Minimum average pressure drop, as set by the TBP
- ❑ Maximum average inlet temperature
- ❑ Air-to-cloth ratio
- ❑ Cleaning cycle

11.6.3 Reviewing Parameters For Other Associated Equipment

- ❑ Parameters from trial burn data (Group A and B parameters)
- ❑ Cyclones
  - ❑ Inlet gas temperature
  - ❑ Gas velocity
  - ❑ Pressure drop
- ❑ Absorber
  - ❑ Inlet gas temperature
  - ❑ Scrubber liquid flow rate
  - ❑ Scrubber liquid inlet and outlet pH
  - ❑ Nozzle pressure
  - ❑ Recirculation and blow down rate
- ❑ Induced- or forced-draft fan
  - ❑ Volumetric flow rate
  - ❑ Temperature
  - ❑ Pressure
  - ❑ Horsepower
- ❑ Packed-bed scrubber
  - ❑ Liquid-to-gas ratio
  - ❑ Scrubber liquid pH
  - ❑ Scrubber liquor blowdown rate
- ❑ Parameters independent of trial burn (Group C parameters)
  - ❑ APCS inlet gas temperature
  - ❑ Maximum total heat input for each chamber
  - ❑ Liquid injection burner settings
    - ❑ Maximum viscosity of pumped waste
    - ❑ Maximum burner turndown

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- ❑ Minimum atomization fluid pressure
- ❑ Minimum waste heating value

- ❑ Minimum and maximum nozzle pressure to scrubber

11.7 REVIEWING PROPOSED DATA FOR USE IN THE RISK ASSESSMENT

- ❑ VOC emission rates including PICs, during each run

- ❑ SVOC emission rates including PICs, during each run

- ❑ PAH emission rates during each run

- ❑ Emission rates for other organic compounds that may be of concern, such as aldehydes, during each run

- ❑ Metal emission rate during each run

- ❑ HCl and Cl_2 emission rates during each run

- ❑ PCDD and PCDF emission rates during each run

- ❑ Particle size distribution

- ❑ TO emission rates

12.0 REVIEWING THE Appendices

- ❑ The TBP and QAPP would have been submitted and approved prior to conducting the trial burn. They may or may not be resubmitted as appendices; however, if they are not included as appendices to the TBR, they should be obtained for use in the TBR review (see Sections 12.1 and 12.2).

- ❑ Stack sampling report (see Section 12.3)

- ❑ Process sampling report (see Section 12.4)

- ❑ QA/QC report (see Section 12.5)

- ❑ Instrument calibration records (see Section 12.6)

- ❑ Performance calculations (see Section 12.7)

- ❑ Field logs (see Section 12.8)

- ❑ Analytical data packages (see Section 12.9)

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12.1 REVIEWING APPENDIX A—TRIAL BURN PLAN

- ❑ The TBP must have been submitted and approved prior to the trial burn; it may or may not be resubmitted as an appendix to the TBR; however, at a minimum, it should be obtained for use in the TBR review
- ❑ Letters of correspondence between the BIF facility and the regulatory agency
- ❑ Notices of deficiency and responses
- ❑ Letter from U.S. EPA stating that the TBP is acceptable for implementation

12.2 REVIEWING APPENDIX B—QUALITY ASSURANCE PROJECT PLAN

- ❑ The trial burn QAPP should have been submitted and approved prior to the trial burn, it may or may not be resubmitted as an appendix to the TBR; however, as a minimum, it should be obtained to assist in the TBR review.
- ❑ Sixteen essential elements of a trial burn QAPP include:
  - ❑ Title page with provisions for approval signatures
  - ❑ Table of contents
  - ❑ Project description
  - ❑ Project organization and responsibility
  - ❑ QA objectives for later measurement, in terms of precision, accuracy, completeness, representativeness, and comparability
  - ❑ Sampling procedures
  - ❑ Sample custody
  - ❑ Calibration procedure and frequency
  - ❑ Analytical procedures
  - ❑ Data reduction, validation, and reporting
  - ❑ Internal QC checks and frequency
  - ❑ Performance and system audits and frequency
  - ❑ Preventive maintenance procedures and schedules
  - ❑ Specific routine procedures to be used to assess data precision, accuracy, and completeness of specific measurement parameters involved
  - ❑ Corrective action
  - ❑ QA reports to management
- ❑ Document control indicator in the top right corner of each page
- ❑ How the trial burn QAPP is contained in the overall plan (incorporated into the TBP or separate from it)

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12.3 REVIEWING APPENDIX C— STACK SAMPLING REPORT

The TBR should include the following subsections:

- ❑ U.S. EPA Method 0010 field data sheets and emission rate calculations (See Section 12.3.1)
- ❑ U.S. EPA Method 23 or 0023A field data sheets and emission rate calculations (See Section 12.3.2)
- ❑ U.S. EPA Method 0012 or 0060 field data sheets and emission rate calculations (See Section 12.3.3)
- ❑ U.S. EPA Method 0013 or 0061 field data sheets and emission rate calculations (See Section 12.3.4)
- ❑ U.S. EPA Method 0030 or 0031 field data sheets and emission rate calculations (See Section 12.3.5)
- ❑ Total organics field data sheets and emission rate calculations (See Section 12.3.6)
- ❑ U.S. EPA Method 0050 or 0051 field data sheets and emission rate calculations (See Section 12.3.7)

During review of these subsections, the TBR review team should evaluate the following:

- ❑ Field data sheets for each sampling method used during the trial burn
- ❑ Emission rate calculations, in consistent units for each method used during the trial burn
- ❑ Calibration records for pretest and post-test calibration of all methods and sampling equipment
- ❑ All calibration records for calibration equipment

12.3.1 Reviewing U.S. EPA Method 0010 Field Data Sheets and Emission Rate Calculations

- ❑ Field data sheets indicating traverse points sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser
- ❑ Filter temperature of 248 ± 25°F
- ❑ Gas temperature entering the sorbent-trap of less than 68°F

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- ❑ Isokinetic sampling rate of 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Minimum sample column calculations
- ❑ SVOC emission rate calculations

12.3.2 Reviewing Method 23 Field Data Sheets and Emission Rate Calculations

- ❑ Field data sheets indicating traverse points; sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser
- ❑ Minimum sample volume required for DRE measurement is 106 dscf; this volume can be used as the absolute minimum for PCDD/PCDF sampling
- ❑ Filter temperature of 248 ± 25°F
- ❑ Gas temperature entering the sorbent-trap of less than 68°F
- ❑ Isokinetic sampling rate of 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Minimum sample column calculations
- ❑ PCDD/PCDF emission rate calculations
- ❑ Demonstrated experience of the analyst in the use of air sampling methods for PCDDs, PCDFs

12.3.3 Reviewing U.S. EPA Method 0012 Field Data Sheets and Emission Rate Calculations

- ❑ Field data sheets (for each traverse point record: sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger])
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations

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- ❑ Metals emission rate calculations

12.3.4 Reviewing U.S. EPA Method 0013 Field Data Sheets and Emission Rate Calculations

- ❑ Field data sheets (for each traverse point records: sampling time; vacuum; stack temperature; velocity head; pressure differential across orifice meter; gas sample volume; gas sample dry-gas meter inlet and outlet temperature; and temperature of gas leaving condenser [last impinger])
- ❑ Maintenance of proper temperature (probe and filter at 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations
- ❑ Hexavalent chromium emission rate calculations
- ❑ First impinger pH

12.3.5 Reviewing U.S. EPA Method 0030 Field Data Sheets and Emission Rate Calculations

- ❑ Sample collection rate
- ❑ Temperature of gas stream entering first trap
- ❑ Leak checks
- ❑ Identification of O-rings
- ❑ Identification of sample cartridge storage conditions
- ❑ Qualifications of sampling personnel
- ❑ Holding time for VOST tubes from time and day of collection to time and day of analysis

12.3.6 Reviewing Total Organics Field Data Sheets and Emission Rate Calculations

- ❑ U.S. EPA Method 0040 field data sheets
- ❑ Field GC results
- ❑ U.S. EPA Method 0010 field data sheets
- ❑ TCO results

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- ❑ GRAV results
- ❑ Unidentified organics emission rate calculations
- ❑ Experience in sampling and analysis techniques

12.3.7 Reviewing U.S. EPA Method 0050 Field Data Sheets and Emission Rate Calculations

- ❑ Field data sheets for each traverse point recording the following:
  - ❑ Sampling time
  - ❑ Vacuum
  - ❑ Stack temperature
  - ❑ Velocity head
  - ❑ Pressure differential across orifice meter
  - ❑ Gas sample volume
  - ❑ Gas sample dry-gas meter inlet and outlet temperature
  - ❑ Temperature of gas leaving condenser (last impinger)
- ❑ Maintenance of proper temperature (probe and filter 248 ± 25°F, train exit gas below 68°F)
- ❑ Whether isokinetic calculations are within 90 to 110 percent
- ❑ Stack flow rate calculations

12.4 REVIEWING APPENDIX D—PROCESS SAMPLING REPORT

The TBR should include subsections on the following:

- ❑ Raw data (see Section 12.4.1)
- ❑ Data summary calculations (see Section 12.4.2)

The TBR review team should evaluate these section for the following information:

- ❑ Sampling equipment, as proposed in the TBP
- ❑ Sampling data forms to see whether location, method, frequency, and presentation agree with TBP
- ❑ Responsibility assignments

Finally, raw data should be spot-checked against data included in the trial burn oversight report.

12.4.1 Reviewing Raw Data

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- ❑ Sampling location
- ❑ Sampling method
- ❑ Sampling frequency
- ❑ Sample preservation
- ❑ Run number, data, and sampler identity
- ❑ Sample identification

Raw data should also be spot-checked against data collected during the trial burn oversight

12.4.2 Reviewing Data Summary Calculations

- ❑ Presentation of summary calculations
- ❑ Whether summary calculations are complete
- ❑ Whether summary calculations are accurate

12.5 REVIEWING APPENDIX E—THE QA/QC REPORT

This section of the TBR contain subsections that include the following:

- ❑ Field sampling QA/QC report (see Section 12.5.1)
- ❑ Laboratory QA/QC report (see Section 12.5.2)
- ❑ Chain-of-custody forms (see Section 12.5.3)

The TBR review team should evaluate the following aspects of this information:

- ❑ Formal presentation of the 16 trial burn QAPP elements
- ❑ QA/QC information on items listed in the explanation
- ❑ Consistency between TBP, trial burn QAPP, and TBR presentation

12.5.1 Reviewing Field Sampling Quality Assurance/Quality Control Report

Using the checklists, the reviewer should evaluate the following:

- ❑ U.S. EPA Method 1

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- ❑ Absence of cyclonic flow

❑ U.S. EPA Method 2

- ❑ Thermocouple calibration range and date
- ❑ Barometer calibration range

❑ U.S. EPA Method 3

- ❑ Leak check for sampling
- ❑ Leak check for analyzers

❑ U.S. EPA Method 4

- ❑ Calibration sheets for vacuum gauge
- ❑ Calibration sheets for thermocouples
- ❑ Calibration sheets for dry-gas meter
- ❑ Proper sampling rate
- ❑ Pump leak checked
- ❑ Leak check on train
- ❑ Train temperature less than 68°F

❑ U.S. EPA Method 5

- ❑ Calibration sheets for sampling nozzle, pitot tube, dry-gas meter and thermometers/thermocouples
- ❑ Leak checks for sample line and pitot lines
- ❑ Proper sampling rate
- ❑ Adequate total sampling time (2-hour minimum) and sampling time at each point
- ❑ Proper temperature maintained (probe and filter 240 ± 25°F, train exit gas less than 68°F)
- ❑ Sampling rate within 90 to 110 percent of isokinetic

❑ U.S. EPA Modified Method 5 (U.S. EPA Method 0010) for semivolatile organics

- ❑ Sample recovery documentation for XAD tubes
- ❑ Sample recovery documentation for blank sample collection
- ❑ Calibration sheets for sampling nozzle, pitot tube, dry-gas meter and thermometers/thermocouples
- ❑ Leak checks for sample line and pitot lines
- ❑ Proper sampling rate
- ❑ Adequate total sampling time (2-hour minimum) and sampling time at each point
- ❑ Proper temperature maintained (probe and filter 240 ± 25°F, train exit gas less than 68°F)

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- ❑ Sampling rate within 90 to 110 percent of isokinetic

- ❑ U.S. EPA Methods 0012 and 0060 - Determination of Metals Emissions from Stationary Sources. Review method for QA/QC procedures and proper sample collection, transfer, and train component cleanup

- ❑ U.S. EPA Methods 0030 and 0031 for volatile organics

  - ❑ Leak checks for the train
  - ❑ Calibration sheets for dry gas meter and thermocouples
  - ❑ Sampling volume, duration, and leak checks for each trap pair recorded
  - ❑ Trip blanks collected
  - ❑ Field data logsheets for each trap pair available

- ❑ U.S. EPA Method 0040 - Total Organics Measurement. Review method for QA/QC procedures and field analytical requirements

- ❑ U.S. EPA Methods 0050 and 0051 - Sampling Method for PM, HCl and Cl_2. Check method for QA/QC, sampling requirements, transfer and train cleanup

- ❑ CO and O_2 CEMS

  - ❑ Leak checks for CO and O_2 sampling locations
  - ❑ Calibration gas concentration (zero and high level)
  - ❑ Calibration gas certificate (whether CO protocol calibration gases have expired)
  - ❑ Whether calibration checks are performed before each run and daily
  - ❑ Whether zero and span calibration drift test is performed during trial burn
  - ❑ Whether sampling and analysis are conducted every 15 seconds during trial burn
  - ❑ Whether data are logged every 60 seconds during trial burn

12.5.2 Reviewing Laboratory Data Summary Report

- ❑ Identification of all reportable data

- ❑ Presentation of field records

- ❑ Calibration data

- ❑ Precision and accuracy results

- ❑ Internal audit results

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- ❑ Data quality assessment report
- ❑ SQL determination summary
- ❑ Flagged data with discussion

12.5.3 Reviewing Chain-of-Custody Forms

- ❑ Completed forms
- ❑ Signatures
- ❑ Sample identification
- ❑ Other information, as required

12.6 REVIEWING APPENDIX F—INSTRUMENT CALIBRATION RECORDS

- ❑ Process monitoring equipment calibration records (see Section 12.6.1)
- ❑ Process control equipment calibration records (see Section 12.6.2)
- ❑ Emission monitoring equipment calibration records (see Section 12.6.3)
- ❑ Stack gas sampling equipment calibration records (see Section 12.6.4)
- ❑ Field analytical equipment calibration records (see Section 12.6.5)

The TBR review team should closely check this information for consistency with the trial burn oversight report.

12.6.1 Reviewing Calibration Records For Process Monitoring Equipment

- ❑ List of process monitoring equipment and measurement devicesoutlined in the TBP
- ❑ Identification and response criteria of each process monitoring device outlined in the trial burn QAPP

The TBR review team should closely check this information for consistency with the information presented in the trial burn oversight report.

12.6.2 Reviewing Calibration Records For Process Control Equipment

- ❑ List of the process control equipment measuring devices outlined in the TBP
- ❑ Calibration records

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- ❑ Identification and response criteria of each process control equipment device outlined in the trial burn QAPP

The TBR review team should closely check this information for consistency with the trial burn oversight report.

12.6.3 Reviewing Calibration Records For Continuous Emission Monitoring Equipment

- ❑ Monitor calibration error for all gases
- ❑ Zero drift of the monitor
- ❑ Calibration drift of the monitor
- ❑ Sample system bias of the monitor

The TBR review team should closely check this information for consistency with the trial burn oversight report.

12.6.4 Reviewing Calibration Records for Stack Gas Sampling Equipment

- ❑ Pitot tube calibration form
- ❑ Thermocouple calibration form
- ❑ Dry-gas meter calibration form (pretest and post-test)
- ❑ Barometer calibration form
- ❑ Sample train nozzle calibration form

12.6.5 Reviewing Calibration Records For Field Analytical Equipment

- ❑ Pre- and post-test calibrations
- ❑ Sampling system bias evaluations
- ❑ Equipment performance and percent recovery
- ❑ Spike and matrix spike evaluations

12.7 REVIEWING APPENDIX G—PERFORMANCE CALCULATIONS

- ❑ DRE calculations
- ❑ DRE of at least 99.99 percent for each POHC (during each run) identified during the trial burn

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- ❑ DRE of at least 99.9999 percent for PCDD/PCDFs, if applicable

12.8 REVIEWING APPENDIX H—FIELD LOGS

- ❑ Notes or logs by program coordinator, unit operation, process, or control room operators of the facility
- ❑ Notes or logs recorded by source testing company coordinator, field crew leader, and equipment operators
- ❑ Notes, logs, or checklists taken by U.S. EPA, state regulatory, and contracted oversight observers
- ❑ Field notes, logs, or checklists prepared by an independent third-party auditor

12.9 REVIEWING APPENDIX I—ANALYTICAL DATA PACKAGES

- ❑ Analytical data package for waste feed parameters
- ❑ Analytical data package for process samples
- ❑ Analytical data package for stack gas samples
- ❑ Information presented in the data packages for:
  - ❑ Sample identification name and number
  - ❑ Analytical method followed
  - ❑ Matrix type
  - ❑ Date, time, and location of sample collection
  - ❑ Person responsible for sample collection and recovery
  - ❑ Temperature of sample when received
  - ❑ Result of the sample analysis and units associated with the number valve
  - ❑ Method detection limit and sample quantitation limit
  - ❑ Spike results
  - ❑ Spike recovery
  - ❑ Matrix spike results
  - ❑ Duplicate matrix spike results
- ❑ Whether the QA/QC objectives of the TBP were met and satisfied
- ❑ Whether the QA/QC objectives of the trial burn QAPP were met and satisfied

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ATTACHMENT C

STACK GAS EMISSION CALCULATIONS

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How to Use the Method 0010 Raw Data Calculation Workbook

The Method 0010 calculation worksheet was written in Excel. The workbook is comprised of two separate worksheets as follows:

1) Determination of stack gas flow rate parameters and percent isokinetic (Flows)
2) Determination of semivolatile organic compound mass emission rates (SVOC)

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Method 0010 Workbook

The two worksheets of this workbook must be used in the following order.

Flows Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are**red** colored.
4) Review and/or print worksheet.
5) A summary of the key input and results data is contained on page 5.

Semivolatile Organic Compound Worksheet (SVOC)

1) Obtain raw laboratory data.
2) Input semivolatile organic contstiuents mass in micrograms on page 1 (total concentration of each constituent in all sample train subsamples). A cell is available for the "<" symbol when the minimum
detection limit is used for the value. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results begin on page 3.

RAW DATA INPUT
FOR
EPA METHOD 0010 FLOW RATE CALCULATIONS

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Po	-	Average Meter Differential Pressure	1.56	in. H_2O
Pb	-	Barometric Pressure	30.11	in. Hg
Tm	-	Average Dry Gas Meter Temperature	94.790	°F
DGMC	-	Dry Gas Meter Correction Factor	0.987	Dimensionless
Vlcg	-	Total Condensate Collected	410.5	grams
Vm	-	Dry Gas Meter Sample Volume	81.140	dcf
T	-	Sampling Time Duration	120.0	min
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	10.00	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
Dn	-	Nozzle Diameter	0.3120	in.
Cp	-	Pitot Tube Coefficient	0.84	Dimensionless
Dp	-	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Ts	-	Average Stack Gas Temperature	141.1	°F
Sp	-	Static Pressure of Gas Stream	0.18	in. H_2O
D	-	Stack Diameter	42.00	in.

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MOISTURE CONTENT AND SAMPLE VOLUME CORRECTION CALCULATIONS

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Pm	-	Absolute Dry Gas Meter Pressure	in. Hg
Po	-	Average Meter Differential Pressure	in. H_2O
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
Pb	-	Barometric Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Standard Volume H_2O Vapor/Unit Weight Liquid (0.04715)	ft^3/g
Tm	-	Average Dry Gas Meter Temperature	°R
Tstd	-	Absolute Standard Temperature (528)	°R
DGMC	-	Dry Gas Meter Correction Factor	Dimensionless
Vlcg	-	Total Condensate Collected	grams
Vm	-	Dry Gas Meter Sample Volume	dcf
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vwstd	-	Volume of Water Vapor Collected, at Standard Conditions	scf
Bws	-	Moisture Content	mole fraction
Bwd	-	Moisture Content	% Volume

TEST DATA

Variable	Data	Variable	Data
Pb =	30.11	Tm =	554.8
Vm =	81.140	Po =	1.56
Vlcg=	410.5	DGMC =	0.987

CALCULATIONS

Pm	=	Pb + (Po/K1) =	30.11 + (1.56/13.6) =	**30.22 in. Hg**
Vmstd	=	$\frac{(Vm)(DGMC)(Pm)(Tstd)}{(Pstd)(Tm)}$ =	$\frac{(81.140)(0.987)(30.22)(528)}{(29.92)(554.8)}$ =	**76.981 dscf**
Vwstd	=	(K2)(Vlcg) =	(0.04715)(410.5) =	**19.355 scf**
Bws	=	$\frac{(Vwstd)}{(Vwstd) + (Vmstd)}$ =	$\frac{19.355}{(19.355)+(76.981)}$ =	**0.2009**
Bwd	=	(Bws)(100 %) =	(0.2009)(100%) =	**20.09 % Volume**

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MOLECULAR WEIGHT DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Md	-	Sample Gas Molecular Weight, Dry Basis	lb/lb-mole
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Bws	-	Moisture Content	mole fraction
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	% Volume
$\%N_2$	-	Nitrogen Concentration, Dry Basis (gas balance)	% Volume
0.32	-	Molecular Weight of Oxygen, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Carbon Monoxide, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Nitrogen, divided by 100%	lb/lb-mole
0.44	-	Molecular Weight of Carbon Dioxide, divided by 100%	lb/lb-mole
18.0	-	Molecular Weight of Water	lb/lb-mole

TEST DATA

Variable	Data	Variable	Data
Bws =	0.2009	%CO =	0.00
$\%N_2$ =	83.20	$\%CO_2$ =	6.80
$\%O_2$ =	10.00		

CALCULATIONS

Md = $(0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$

Md = $(0.44)(6.80) + (0.32)(10.00) + (0.28)(83.20 + 0.00)$

Md = **29.488 lb/lb-mol**

Ms = $(Md)(1 - Bws) + (18.0)(Bws)$

Ms = $(29.488)(1 - 0.2009) + (18.0)(0.2009)$

Ms = **27.180 lb/lb-mol**

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VELOCITY AND VOLUMETRIC FLOW RATE DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Cp	-	Pitot Tube Coefficient	Dimensionless
Vs	-	Stack Gas Velocity	ft/sec
Qsd	-	Volumetric Flow Rate at Standard Conditions, Dry Basis	dscfm
Qact	-	Volumetric Flow Rate, Wet Basis	cfm
Bws	-	Moisture Content	mole fraction
Dp	-	Avg. Sq. Root of Velocity Head	in. $H_2O^{0.5}$
Pb	-	Barometric Pressure	in. Hg
Kp	-	Constant = 85.49 (ft)(lb/lb-mol)(in.Hg^0.5)/(s)(°R)(in.H2O)	
Ts	-	Average Stack Gas Temperature	°R
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Sp	-	Static Pressure of Gas Stream	in. H_2O
Tstd	-	Absolute Standard Temperature (528)	°R
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
CSA	-	Stack Cross-Sectional Area	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Conversion Factor (60)	sec/min
Pi	-	Constant (3.1416)	Dimensionless
D	-	Stack Diameter	in.

TEST DATA

Variable	Data	Variable	Data	Variable	Data
Ms =	27.180	Dp =	0.4593	Cp =	0.84
Bws =	0.2009	Pb =	30.11	D =	42.00
Sp =	0.18	Ts =	601.1		

CALCULATIONS

Ps = Pb + (Sp/K1) = 30.11 + (0.18/13.6) = **30.12 in. Hg**

Vs = (Kp)(Cp)(Dp)[(Ts)/(Ms)(Ps)]^0.5

Vs = (85.49)(0.84)(0.4593)[601.1/(27.180)(30.12)]^0.5 = **28.26 ft/sec**

CSA = (Pi)(D^2)/[(4)(144)] = (3.1416)(42.00)^2/[(4)(144)] = **9.62 ft^2**

Qact = (Vs)(CSA)(K2) = (28.26)(9.62)(60) = **16311.7 cfm**

$$Qsd = \frac{(Qact)(1-Bws)(Tstd)(Ps)}{(Ts)(Pstd)} = \frac{(16311.7)(1 - 0.2009)(528)(30.12)}{(601.1)(29.92)}$$

Qsd = **11526.1 dscfm**

FLOW RATE DATA SUMMARY

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable	Definition	Value	Units
	INPUT DATA SUMMARY		
$\%CO_2$	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
%CO	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
$\%O_2$	Oxygen Concentration, Dry Basis	10.00	% Volume
$\%N_2$	Nitrogen Concentration, Dry Basis (gas balance)	83.20	% Volume
Pb	Barometric Pressure	30.11	in. Hg
Sp	Static Pressure of Gas Stream	0.18	in. H_2O
Po	Average Meter Differential Pressure	1.56	in. H_2O
Ts	Average Stack Gas Temperature	601.1	°R
Tm	Average Dry Gas Meter Temperature	554.8	°R
Vlcg	Total Condensate Collected	410.5	grams
Vm	Dry Gas Meter Sample Volume	81.140	dcf
DGMC	Dry Gas Meter Correction Factor	0.987	Dimensionless
Dp	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Cp	Pitot Tube Coefficient	0.84	Dimensionless
D	Stack Diameter	42.00	in.
	RESULTS SUMMARY		
Md	Sample Gas Molecular Weight, Dry Basis	29.488	lb/lb-mole
Ms	Sample Gas Molecular Weight, Wet Basis	27.180	lb/lb-mole
Ps	Absolute Stack Gas Pressure	30.12	in. Hg
Pm	Absolute Dry Gas Meter Pressure	30.22	in. Hg
Vmstd	Dry Gas Meter Sample Volume, at Standard Conditions	76.981	dscf
Vwstd	Volume of Water Vapor Collected, at Standard Conditions	19.355	scf
Bws	Moisture Content	0.2009	mole fraction
Bwd	Moisture Content	20.09	% Volume
CSA	Stack Cross-Sectional Area	9.62	ft^2
Vs	Stack Gas Velocity	28.26	ft/sec
Qact	Volumetric Flow Rate, Wet Basis	16311.7	cfm
Qsd	Volumetric Flow Rate, at Standard Conditions, Dry Basis	11526.1	dscfm
I	Isokinetic Sampling Rate	100.86	%

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ISOKINETIC SAMPLING DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable			Units
I	-	Isokinetic Sampling Rate	%
Ts	-	Average Stack Gas Temperature	°R
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vs	-	Stack Gas Velocity	ft/sec
T	-	Sampling Time Duration	minutes
An	-	Cross-Sectional Area of Nozzle	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
Dn	-	Nozzle Diameter	in.
Vlcg	-	Total Condensate Collected	grams
Pi	-	Constant (3.1416)	dimensionless
K1	-	Conversion Factor (144)	in^2/ft^2
K2	-	Conversion Factor (100)	Percent
K3	-	Conversion Factor (17.64)	°R/in. Hg
K4	-	Conversion Factor (0.002669)	$Hg\text{-}ft^3/ml\text{-}°R$
K5	-	Conversion Factor (60)	sec/min

TEST DATA

Variable		Data	Variable	Data	Variable	Data
Vmstd	=	76.981	Ps =	30.12	K2 =	100
Vs	=	28.26	T =	120.0	K3 =	17.64
Vlcg	=	410.5	Dn =	0.312	K4 =	0.002669
Ts	=	601.1	K1 =	144	K5 =	60

CALCULATIONS

An = (Pi)(Dn)^2/[(4)(K1)]

An = (3.1416)(0.312)^2/[(4)(144)] = **0.000531 ft^2**

$$I = \frac{(K2)(Ts)[(Vmstd/K3) + (K4)(Vlcg)]}{(K5)(Vs)(An)(Ps)(T)}$$

$$I = \frac{(100)(601.1)[(76.981/17.64) + (0.002669)(410.50)]}{(60)(28.26)(0.000531)(30.12)(120.0)} = \mathbf{100.86\ \%}$$

US EPA ARCHIVE DOCUMENT

How to Use the Method 0050 Raw Data Calculation Workbook

The Method 0050 calculation worksheet was written in Excel. The workbook is comprised of three separate worksheets as follows:

1) Determination of stack gas flow rate parameters and percent isokinetic (Flows)
2) Determination of hydrogen chloride and chlorine mass emission rates (HCl-Cl_2)
3) Determination of particulate matter mass emission rate (PM)

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Method 0050 Workbook

The three worksheets of this workbook must be used in the following order.

Flows Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are **red** colored.
4) Review and/or print worksheet.
5) A summary of the key input and results data is contained on page 5.

HCl-Cl_2 Worksheet (HCl-Cl_2)

1) Obtain raw laboratory data.
2) Input HCl and Cl_2 mass in milligrams on page 1. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results are contained on page 2

PM Worksheet (PM)

1) Obtain raw laboratory data.
2) Input probe wash, filter, and acetone rinse raw data. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results are contained on page 2.

RAW DATA INPUT
FOR
HYDROGEN CHLORIDE AND CHLORINE EMISSION CALCULATIONS

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Cm	-	Hydrogen Chloride Concentration	45.40	mg
Cn	-	Chlorine Concentration	62.00	mg

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HYDROGEN CHLORIDE AND CHLORINE EMISSION RATE CALCULATIONS

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Em	-	Hydrogen Chloride Mass Emission Rate	lb/hr
En	-	Chlorine Mass Emission Rate	lb/hr
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Cm	-	Hydrogen Chloride Concentration	mg
Cn	-	Chlorine Concentration	mg
Qsd	-	Volumetric Flow Rate, at Standard Conditions, Dry Basis	dscfm
K1	-	Conversion Factor (60)	min/hour
K2	-	Conversion Factor (0.002205)	lb/g
K3	-	Conversion Factor (1000)	mg/g

TEST DATA

Variable	Data	Variable	Data
Vmstd =	76.981	Qsd =	11,526.1
Cm =	45.40	Cn =	62.00

CALCULATIONS

$$Em = \frac{(Cm)(Qsd)(K1)(K2)}{(Vmstd)(K3)} = \frac{(45.40)(11526.1)(60)(0.002205)}{(76.981)(1000)} =$$

Em **0.90 lb/hr**

$$En = \frac{(Cn)(Qsd)(K1)(K2)}{(Vmstd)(K3)} = \frac{(62.00)(11526.1)(60)(0.002205)}{(76.981)(1000)} =$$

En = **1.23 lb/hr**

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How to Use the Methods 0012 and 0060 Raw Data Calculation Workbook

The Methods 0012 and 0060 calculation worksheet was written in Excel. The workbook is comprised of three separate worksheets as follows:

1) Determination of stack gas flow rate parameters and percent isokinetic (Flows)
2) Determination of metal constituents mass emission rates (Metal)
3) Determination of particulate matter mass emission rate (PM)

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Methods 0012 and 0060 Workbook

The three worksheets of this workbook must be used in the following order.

Flows Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are **red** colored.
4) Review and/or print worksheet.
5) A summary of the key input and results data is contained on page 5.

Metals Worksheet (Metal)

1) Obtain raw laboratory data.
2) Input metals mass in micrograms on page 1 (total concentration from all sample train subsamples). A cell
   is available for the "<" symbol when the minimum detection limit is used for the value. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results begin on page 2.

PM Worksheet (PM)

1) Obtain raw laboratory data.
2) Input probe wash, filter, and acetone rinse raw data. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results are contained on page 2.

RAW DATA INPUT
FOR
EPA METHODS 0012 AND 0060 FLOW RATE CALCULATIONS

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Po	-	Average Meter Differential Pressure	1.56	in. H_2O
Pb	-	Barometric Pressure	30.11	in. Hg
Tm	-	Average Dry Gas Meter Temperature	94.790	°F
DGMC	-	Dry Gas Meter Correction Factor	0.987	Dimensionless
Vlcg	-	Total Condensate Collected	410.5	grams
Vm	-	Dry Gas Meter Sample Volume	81.140	dcf
T	-	Sampling Time Duration	120.0	min
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	10.00	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
Dn	-	Nozzle Diameter	0.3120	in.
Cp	-	Pitot Tube Coefficient	0.84	Dimensionless
Dp	-	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Ts	-	Average Stack Gas Temperature	141.1	°F
Sp	-	Static Pressure of Gas Stream	0.18	in. H_2O
D	-	Stack Diameter	42.00	in.

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MOISTURE CONTENT AND SAMPLE VOLUME CORRECTION CALCULATIONS

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Pm	-	Absolute Dry Gas Meter Pressure	in. Hg
Po	-	Average Meter Differential Pressure	in. H_2O
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
Pb	-	Barometric Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Standard Volume H_2O Vapor/Unit Weight Liquid (0.04715)	ft^3/g
Tm	-	Average Dry Gas Meter Temperature	°R
Tstd	-	Absolute Standard Temperature (528)	°R
DGMC	-	Dry Gas Meter Correction Factor	Dimensionless
Vlcg	-	Total Condensate Collected	grams
Vm	-	Dry Gas Meter Sample Volume	dcf
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vwstd	-	Volume of Water Vapor Collected, at Standard Conditions	scf
Bws	-	Moisture Content	mole fraction
Bwd	-	Moisture Content	% Volume

TEST DATA

Variable	Data	Variable	Data
Pb =	30.11	Tm =	554.8
Vm =	81.140	Po =	1.56
Vlcg=	410.5	DGMC =	0.987

CALCULATIONS

Pm	=	Pb + (Po/K1) =	30.11 + (1.56/13.6) =	**30.22 in. Hg**
Vmstd	=	$\frac{(Vm)(DGMC)(Pm)(Tstd)}{(Pstd)(Tm)}$ =	$\frac{(81.140)(0.987)(30.22)(528)}{(29.92)(554.8)}$ =	**76.981 dscf**
Vwstd	=	(K2)(Vlcg) =	(0.04715)(410.5) =	**19.355 scf**
Bws	=	$\frac{(Vwstd)}{(Vwstd) + (Vmstd)}$ =	$\frac{19.355}{(19.355)+(76.981)}$ =	**0.2009**
Bwd	=	(Bws)(100 %) =	(0.2009)(100%) =	**20.09 % Volume**

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MOLECULAR WEIGHT DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Md	-	Sample Gas Molecular Weight, Dry Basis	lb/lb-mole
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Bws	-	Moisture Content	mole fraction
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	% Volume
$\%N_2$	-	Nitrogen Concentration, Dry Basis (gas balance)	% Volume
0.32	-	Molecular Weight of Oxygen, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Carbon Monoxide, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Nitrogen, divided by 100%	lb/lb-mole
0.44	-	Molecular Weight of Carbon Dioxide, divided by 100%	lb/lb-mole
18.0	-	Molecular Weight of Water	lb/lb-mole

TEST DATA

Variable	Data	Variable	Data
Bws =	0.2009	%CO =	0.00
$\%N_2$ =	83.20	$\%CO_2$ =	6.80
$\%O_2$ =	10.00		

CALCULATIONS

Md = $(0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$

Md = $(0.44)(6.80) + (0.32)(10.00) + (0.28)(83.20 + 0.00)$

Md = **29.488 lb/lb-mol**

Ms = $(Md)(1 - Bws) + (18.0)(Bws)$

Ms = $(29.488)(1 - 0.2009) + (18.0)(0.2009)$

Ms = **27.180 lb/lb-mol**

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VELOCITY AND VOLUMETRIC FLOW RATE DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Cp	-	Pitot Tube Coefficient	Dimensionless
Vs	-	Stack Gas Velocity	ft/sec
Qsd	-	Volumetric Flow Rate at Standard Conditions, Dry Basis	dscfm
Qact	-	Volumetric Flow Rate, Wet Basis	cfm
Bws	-	Moisture Content	mole fraction
Dp	-	Avg. Sq. Root of Velocity Head	in. $H_2O^{0.5}$
Pb	-	Barometric Pressure	in. Hg
Kp	-	Constant = 85.49 (ft)(lb/lb-mol)(in.Hg^0.5)/(s)(°R)(in.H2O)	
Ts	-	Average Stack Gas Temperature	°R
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Sp	-	Static Pressure of Gas Stream	in. H_2O
Tstd	-	Absolute Standard Temperature (528)	°R
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
CSA	-	Stack Cross-Sectional Area	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Conversion Factor (60)	sec/min
Pi	-	Constant (3.1416)	Dimensionless
D	-	Stack Diameter	in.

TEST DATA

Variable	Data	Variable	Data	Variable	Data
Ms =	27.180	Dp =	0.4593	Cp =	0.84
Bws =	0.2009	Pb =	30.11	D =	42.00
Sp =	0.18	Ts =	601.1		

CALCULATIONS

Ps = Pb + (Sp/K1) = 30.11 + (0.18/13.6) = **30.12 in. Hg**

Vs = (Kp)(Cp)(Dp)[(Ts)/(Ms)(Ps)]^0.5

Vs = (85.49)(0.84)(0.4593)[601.1/(27.180)(30.12)]^0.5 = **28.26 ft/sec**

CSA = (Pi)(D^2)/[(4)(144)] = (3.1416)(42.00)^2/[(4)(144)] = **9.62 ft^2**

Qact = (Vs)(CSA)(K2) = (28.26)(9.62)(60) = **16311.7 cfm**

$$Qsd = \frac{(Qact)(1-Bws)(Tstd)(Ps)}{(Ts)(Pstd)} = \frac{(16311.7)(1 - 0.2009)(528)(30.12)}{(601.1)(29.92)}$$

Qsd = **11526.1 dscfm**

FLOW RATE DATA SUMMARY

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable	Definition	Value	Units
	INPUT DATA SUMMARY		
$\%CO_2$	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
%CO	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
$\%O_2$	Oxygen Concentration, Dry Basis	10.00	% Volume
$\%N_2$	Nitrogen Concentration, Dry Basis (gas balance)	83.20	% Volume
Pb	Barometric Pressure	30.11	in. Hg
Sp	Static Pressure of Gas Stream	0.18	in. H_2O
Po	Average Meter Differential Pressure	1.56	in. H_2O
Ts	Average Stack Gas Temperature	601.1	°R
Tm	Average Dry Gas Meter Temperature	554.8	°R
Vlcg	Total Condensate Collected	410.5	grams
Vm	Dry Gas Meter Sample Volume	81.140	dcf
DGMC	Dry Gas Meter Correction Factor	0.987	Dimensionless
Dp	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Cp	Pitot Tube Coefficient	0.84	Dimensionless
D	Stack Diameter	42.00	in.
	RESULTS SUMMARY		
Md	Sample Gas Molecular Weight, Dry Basis	29.488	lb/lb-mole
Ms	Sample Gas Molecular Weight, Wet Basis	27.180	lb/lb-mole
Ps	Absolute Stack Gas Pressure	30.12	in. Hg
Pm	Absolute Dry Gas Meter Pressure	30.22	in. Hg
Vmstd	Dry Gas Meter Sample Volume, at Standard Conditions	76.981	dscf
Vwstd	Volume of Water Vapor Collected, at Standard Conditions	19.355	scf
Bws	Moisture Content	0.2009	mole fraction
Bwd	Moisture Content	20.09	% Volume
CSA	Stack Cross-Sectional Area	9.62	ft^2
Vs	Stack Gas Velocity	28.26	ft/sec
Qact	Volumetric Flow Rate, Wet Basis	16311.7	cfm
Qsd	Volumetric Flow Rate, at Standard Conditions, Dry Basis	11526.1	dscfm
I	Isokinetic Sampling Rate	100.86	%

US EPA ARCHIVE DOCUMENT

ISOKINETIC SAMPLING DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable			Units
I	-	Isokinetic Sampling Rate	%
Ts	-	Average Stack Gas Temperature	°R
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vs	-	Stack Gas Velocity	ft/sec
T	-	Sampling Time Duration	minutes
An	-	Cross-Sectional Area of Nozzle	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
Dn	-	Nozzle Diameter	in.
Vlcg	-	Total Condensate Collected	grams
Pi	-	Constant (3.1416)	dimensionless
K1	-	Conversion Factor (144)	in^2/ft^2
K2	-	Conversion Factor (100)	Percent
K3	-	Conversion Factor (17.64)	°R/in. Hg
K4	-	Conversion Factor (0.002669)	$Hg\text{-}ft^3/ml\text{-}°R$
K5	-	Conversion Factor (60)	sec/min

TEST DATA

Variable		Data	Variable	Data	Variable	Data
Vmstd	=	76.981	Ps =	30.12	K2 =	100
Vs	=	28.26	T =	120.0	K3 =	17.64
Vlcg	=	410.5	Dn =	0.312	K4 =	0.002669
Ts	=	601.1	K1 =	144	K5 =	60

CALCULATIONS

An = (Pi)(Dn)^2/[(4)(K1)]

An = (3.1416)(0.312)^2/[(4)(144)] = **0.000531 ft^2**

$$I = \frac{(K2)(Ts)[(Vmstd/K3) + (K4)(Vlcg)]}{(K5)(Vs)(An)(Ps)(T)}$$

$$I = \frac{(100)(601.1)[(76.981/17.64) + (0.002669)(410.50)]}{(60)(28.26)(0.000531)(30.12)(120.0)} = \mathbf{100.86\ \%}$$

US EPA ARCHIVE DOCUMENT

How to Use the Methods 0013 and 0061 (Chrome$^{+6)}$ Raw Data Calculation Workbook

The Methods 0013 and 0061calculation worksheet was written in Excel. The workbook is comprised of two separate worksheets as follows:

1) Determination of stack gas flow rate parameters and percent isokinetic (Flows)
2) Determination of Chrome^{+6} mass emission rates (Chrome^{+6})

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Method Chrome^{+6} Workbook

The two worksheets of this workbook must be used in the following order.

Flows Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are **red** colored.
4) Review and/or print worksheet.
5) A summary of the key input and results data is contained on page 5.

Chrome^{+6} Worksheet (Chrome^{+6})

1) Obtain raw laboratory data.
2) Input Chrome^{+6} mass in micrograms on page 1 (total concentration of all sample train subsamples). A cell is available for the "<" symbol when the minimum detection limit is used for the value. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results are presented at the bottom of page 1.

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RAW DATA INPUT
FOR
EPA METHODS 0013 AND 0061 FLOW RATE CALCULATIONS

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Po	-	Average Meter Differential Pressure	1.56	in. H_2O
Pb	-	Barometric Pressure	30.11	in. Hg
Tm	-	Average Dry Gas Meter Temperature	94.790	°F
DGMC	-	Dry Gas Meter Correction Factor	0.987	Dimensionless
Vlcg	-	Total Condensate Collected	410.5	grams
Vm	-	Dry Gas Meter Sample Volume	81.140	dcf
T	-	Sampling Time Duration	120.0	min
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	10.00	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
Dn	-	Nozzle Diameter	0.3120	in.
Cp	-	Pitot Tube Coefficient	0.84	Dimensionless
Dp	-	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Ts	-	Average Stack Gas Temperature	141.1	°F
Sp	-	Static Pressure of Gas Stream	0.18	in. H_2O
D	-	Stack Diameter	42.00	in.

US EPA ARCHIVE DOCUMENT

MOISTURE CONTENT AND SAMPLE VOLUME CORRECTION CALCULATIONS

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Pm	-	Absolute Dry Gas Meter Pressure	in. Hg
Po	-	Average Meter Differential Pressure	in. H_2O
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
Pb	-	Barometric Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Standard Volume H_2O Vapor/Unit Weight Liquid (0.04715)	ft^3/g
Tm	-	Average Dry Gas Meter Temperature	°R
Tstd	-	Absolute Standard Temperature (528)	°R
DGMC	-	Dry Gas Meter Correction Factor	Dimensionless
Vlcg	-	Total Condensate Collected	grams
Vm	-	Dry Gas Meter Sample Volume	dcf
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vwstd	-	Volume of Water Vapor Collected, at Standard Conditions	scf
Bws	-	Moisture Content	mole fraction
Bwd	-	Moisture Content	% Volume

TEST DATA

Variable	Data	Variable	Data
Pb =	30.11	Tm =	554.8
Vm =	81.140	Po =	1.56
Vlcg=	410.5	DGMC =	0.987

CALCULATIONS

Pm	=	Pb + (Po/K1) =	30.11 + (1.56/13.6) =	**30.22 in. Hg**
Vmstd	=	$\frac{(Vm)(DGMC)(Pm)(Tstd)}{(Pstd)(Tm)}$ =	$\frac{(81.140)(0.987)(30.22)(528)}{(29.92)(554.8)}$ =	**76.981 dscf**
Vwstd	=	(K2)(Vlcg) =	(0.04715)(410.5) =	**19.355 scf**
Bws	=	$\frac{(Vwstd)}{(Vwstd) + (Vmstd)}$ =	$\frac{19.355}{(19.355)+(76.981)}$ =	**0.2009**
Bwd	=	(Bws)(100 %) =	(0.2009)(100%) =	**20.09 % Volume**

US EPA ARCHIVE DOCUMENT

MOLECULAR WEIGHT DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Md	-	Sample Gas Molecular Weight, Dry Basis	lb/lb-mole
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Bws	-	Moisture Content	mole fraction
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	% Volume
$\%N_2$	-	Nitrogen Concentration, Dry Basis (gas balance)	% Volume
0.32	-	Molecular Weight of Oxygen, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Carbon Monoxide, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Nitrogen, divided by 100%	lb/lb-mole
0.44	-	Molecular Weight of Carbon Dioxide, divided by 100%	lb/lb-mole
18.0	-	Molecular Weight of Water	lb/lb-mole

TEST DATA

Variable	Data	Variable	Data
Bws =	0.2009	%CO =	0.00
$\%N_2$ =	83.20	$\%CO_2$ =	6.80
$\%O_2$ =	10.00		

CALCULATIONS

Md = $(0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$

Md = $(0.44)(6.80) + (0.32)(10.00) + (0.28)(83.20 + 0.00)$

Md = **29.488 lb/lb-mol**

Ms = $(Md)(1 - Bws) + (18.0)(Bws)$

Ms = $(29.488)(1 - 0.2009) + (18.0)(0.2009)$

Ms = **27.180 lb/lb-mol**

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VELOCITY AND VOLUMETRIC FLOW RATE DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Cp	-	Pitot Tube Coefficient	Dimensionless
Vs	-	Stack Gas Velocity	ft/sec
Qsd	-	Volumetric Flow Rate at Standard Conditions, Dry Basis	dscfm
Qact	-	Volumetric Flow Rate, Wet Basis	cfm
Bws	-	Moisture Content	mole fraction
Dp	-	Avg. Sq. Root of Velocity Head	in. $H_2O^{0.5}$
Pb	-	Barometric Pressure	in. Hg
Kp	-	Constant = 85.49 (ft)(lb/lb-mol)(in.Hg^0.5)/(s)(°R)(in.H2O)	
Ts	-	Average Stack Gas Temperature	°R
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Sp	-	Static Pressure of Gas Stream	in. H_2O
Tstd	-	Absolute Standard Temperature (528)	°R
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
CSA	-	Stack Cross-Sectional Area	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Conversion Factor (60)	sec/min
Pi	-	Constant (3.1416)	Dimensionless
D	-	Stack Diameter	in.

TEST DATA

Variable	Data	Variable	Data	Variable	Data
Ms =	27.180	Dp =	0.4593	Cp =	0.84
Bws =	0.2009	Pb =	30.11	D =	42.00
Sp =	0.18	Ts =	601.1		

CALCULATIONS

Ps = Pb + (Sp/K1) = 30.11 + (0.18/13.6) = **30.12 in. Hg**

Vs = (Kp)(Cp)(Dp)[(Ts)/(Ms)(Ps)]^0.5

Vs = (85.49)(0.84)(0.4593)[601.1/(27.180)(30.12)]^0.5 = **28.26 ft/sec**

CSA = (Pi)(D^2)/[(4)(144)] = (3.1416)(42.00)^2/[(4)(144)] = **9.62 ft^2**

Qact = (Vs)(CSA)(K2) = (28.26)(9.62)(60) = **16311.7 cfm**

$$Qsd = \frac{(Qact)(1-Bws)(Tstd)(Ps)}{(Ts)(Pstd)} = \frac{(16311.7)(1 - 0.2009)(528)(30.12)}{(601.1)(29.92)}$$

Qsd = **11526.1 dscfm**

FLOW RATE DATA SUMMARY

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable	Definition	Value	Units
	INPUT DATA SUMMARY		
$\%CO_2$	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
%CO	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
$\%O_2$	Oxygen Concentration, Dry Basis	10.00	% Volume
$\%N_2$	Nitrogen Concentration, Dry Basis (gas balance)	83.20	% Volume
Pb	Barometric Pressure	30.11	in. Hg
Sp	Static Pressure of Gas Stream	0.18	in. H_2O
Po	Average Meter Differential Pressure	1.56	in. H_2O
Ts	Average Stack Gas Temperature	601.1	°R
Tm	Average Dry Gas Meter Temperature	554.8	°R
Vlcg	Total Condensate Collected	410.5	grams
Vm	Dry Gas Meter Sample Volume	81.140	dcf
DGMC	Dry Gas Meter Correction Factor	0.987	Dimensionless
Dp	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Cp	Pitot Tube Coefficient	0.84	Dimensionless
D	Stack Diameter	42.00	in.
	RESULTS SUMMARY		
Md	Sample Gas Molecular Weight, Dry Basis	29.488	lb/lb-mole
Ms	Sample Gas Molecular Weight, Wet Basis	27.180	lb/lb-mole
Ps	Absolute Stack Gas Pressure	30.12	in. Hg
Pm	Absolute Dry Gas Meter Pressure	30.22	in. Hg
Vmstd	Dry Gas Meter Sample Volume, at Standard Conditions	76.981	dscf
Vwstd	Volume of Water Vapor Collected, at Standard Conditions	19.355	scf
Bws	Moisture Content	0.2009	mole fraction
Bwd	Moisture Content	20.09	% Volume
CSA	Stack Cross-Sectional Area	9.62	ft^2
Vs	Stack Gas Velocity	28.26	ft/sec
Qact	Volumetric Flow Rate, Wet Basis	16311.7	cfm
Qsd	Volumetric Flow Rate, at Standard Conditions, Dry Basis	11526.1	dscfm
I	Isokinetic Sampling Rate	100.86	%

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ISOKINETIC SAMPLING DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable			Units
I	-	Isokinetic Sampling Rate	%
Ts	-	Average Stack Gas Temperature	°R
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vs	-	Stack Gas Velocity	ft/sec
T	-	Sampling Time Duration	minutes
An	-	Cross-Sectional Area of Nozzle	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
Dn	-	Nozzle Diameter	in.
Vlcg	-	Total Condensate Collected	grams
Pi	-	Constant (3.1416)	dimensionless
K1	-	Conversion Factor (144)	in^2/ft^2
K2	-	Conversion Factor (100)	Percent
K3	-	Conversion Factor (17.64)	°R/in. Hg
K4	-	Conversion Factor (0.002669)	$Hg\text{-}ft^3/ml\text{-}°R$
K5	-	Conversion Factor (60)	sec/min

TEST DATA

Variable		Data	Variable	Data	Variable	Data
Vmstd	=	76.981	Ps =	30.12	K2 =	100
Vs	=	28.26	T =	120.0	K3 =	17.64
Vlcg	=	410.5	Dn =	0.312	K4 =	0.002669
Ts	=	601.1	K1 =	144	K5 =	60

CALCULATIONS

An = (Pi)(Dn)^2/[(4)(K1)]

An = (3.1416)(0.312)^2/[(4)(144)] = **0.000531 ft^2**

$$I = \frac{(K2)(Ts)[(Vmstd/K3) + (K4)(Vlcg)]}{(K5)(Vs)(An)(Ps)(T)}$$

$$I = \frac{(100)(601.1)[(76.981/17.64) + (0.002669)(410.50)]}{(60)(28.26)(0.000531)(30.12)(120.0)} = \mathbf{100.86\ \%}$$

US EPA ARCHIVE DOCUMENT

How to Use the Methods 0023 and 0023A Raw Data Calculation Workbook

The Methods 0023 and 0023A calculation worksheet was written in Excel. The workbook is comprised of two separate worksheets as follows:

1) Determination of stack gas flow rate parameters and percent isokinetic (Flows)
2) Determination of Dioxin/Furan mass emission rates (SVOC)

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Methods 0023 and 0023A Workbook

The two worksheets of this workbook must be used in the following order.

Flows Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are **red** colored.
4) Review and/or print worksheet.
5) A summary of the key input and results data is contained on page 5.

Dioxin/Furan Worksheet (SVOC)

1) Obtain raw laboratory data.
2) Input Dioxin/Furan contstiuents mass in micrograms on page 1 (total concentration of each constituent in all sample train subsamples). A cell is available for the "<" symbol when the minimum detection limitis used for the value. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results begin on page 2.

RAW DATA INPUT
FOR
EPA METHODS 0023 AND 0023A FLOW RATE CALCULATIONS

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition	Data	Units
Po	-	Average Meter Differential Pressure	1.56	in. H_2O
Pb	-	Barometric Pressure	30.11	in. Hg
Tm	-	Average Dry Gas Meter Temperature	94.790	°F
DGMC	-	Dry Gas Meter Correction Factor	0.987	Dimensionless
Vlcg	-	Total Condensate Collected	410.5	grams
Vm	-	Dry Gas Meter Sample Volume	81.140	dcf
T	-	Sampling Time Duration	120.0	min
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	10.00	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
Dn	-	Nozzle Diameter	0.3120	in.
Cp	-	Pitot Tube Coefficient	0.84	Dimensionless
Dp	-	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Ts	-	Average Stack Gas Temperature	141.1	°F
Sp	-	Static Pressure of Gas Stream	0.18	in. H_2O
D	-	Stack Diameter	42.00	in.

US EPA ARCHIVE DOCUMENT

MOISTURE CONTENT AND SAMPLE VOLUME CORRECTION CALCULATIONS

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Pm	-	Absolute Dry Gas Meter Pressure	in. Hg
Po	-	Average Meter Differential Pressure	in. H_2O
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
Pb	-	Barometric Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Standard Volume H_2O Vapor/Unit Weight Liquid (0.04715)	ft^3/g
Tm	-	Average Dry Gas Meter Temperature	°R
Tstd	-	Absolute Standard Temperature (528)	°R
DGMC	-	Dry Gas Meter Correction Factor	Dimensionless
Vlcg	-	Total Condensate Collected	grams
Vm	-	Dry Gas Meter Sample Volume	dcf
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vwstd	-	Volume of Water Vapor Collected, at Standard Conditions	scf
Bws	-	Moisture Content	mole fraction
Bwd	-	Moisture Content	% Volume

TEST DATA

Variable	Data	Variable	Data
Pb =	30.11	Tm =	554.8
Vm =	81.140	Po =	1.56
Vlcg=	410.5	DGMC =	0.987

CALCULATIONS

Pm	=	Pb + (Po/K1) =	30.11 + (1.56/13.6) =	**30.22 in. Hg**
Vmstd	=	$\frac{(Vm)(DGMC)(Pm)(Tstd)}{(Pstd)(Tm)}$ =	$\frac{(81.140)(0.987)(30.22)(528)}{(29.92)(554.8)}$ =	**76.981 dscf**
Vwstd	=	(K2)(Vlcg) =	(0.04715)(410.5) =	**19.355 scf**
Bws	=	$\frac{(Vwstd)}{(Vwstd) + (Vmstd)}$ =	$\frac{19.355}{(19.355)+(76.981)}$ =	**0.2009**
Bwd	=	(Bws)(100 %) =	(0.2009)(100%) =	**20.09 % Volume**

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MOLECULAR WEIGHT DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Md	-	Sample Gas Molecular Weight, Dry Basis	lb/lb-mole
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Bws	-	Moisture Content	mole fraction
$\%CO_2$	-	Carbon Dioxide Concentration, Dry Basis	% Volume
%CO	-	Carbon Monoxide Concentration, Dry Basis	% Volume
$\%O_2$	-	Oxygen Concentration, Dry Basis	% Volume
$\%N_2$	-	Nitrogen Concentration, Dry Basis (gas balance)	% Volume
0.32	-	Molecular Weight of Oxygen, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Carbon Monoxide, divided by 100%	lb/lb-mole
0.28	-	Molecular Weight of Nitrogen, divided by 100%	lb/lb-mole
0.44	-	Molecular Weight of Carbon Dioxide, divided by 100%	lb/lb-mole
18.0	-	Molecular Weight of Water	lb/lb-mole

TEST DATA

Variable	Data	Variable	Data
Bws =	0.2009	%CO =	0.00
$\%N_2$ =	83.20	$\%CO_2$ =	6.80
$\%O_2$ =	10.00		

CALCULATIONS

Md = $(0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$

Md = $(0.44)(6.80) + (0.32)(10.00) + (0.28)(83.20 + 0.00)$

Md = **29.488 lb/lb-mol**

Ms = $(Md)(1 - Bws) + (18.0)(Bws)$

Ms = $(29.488)(1 - 0.2009) + (18.0)(0.2009)$

Ms = **27.180 lb/lb-mol**

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VELOCITY AND VOLUMETRIC FLOW RATE DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable		Definition	Units
Cp	-	Pitot Tube Coefficient	Dimensionless
Vs	-	Stack Gas Velocity	ft/sec
Qsd	-	Volumetric Flow Rate at Standard Conditions, Dry Basis	dscfm
Qact	-	Volumetric Flow Rate, Wet Basis	cfm
Bws	-	Moisture Content	mole fraction
Dp	-	Avg. Sq. Root of Velocity Head	in. $H_2O^{0.5}$
Pb	-	Barometric Pressure	in. Hg
Kp	-	Constant = 85.49 (ft)(lb/lb-mol)(in.Hg^0.5)/(s)(°R)(in.H2O)	
Ts	-	Average Stack Gas Temperature	°R
Ms	-	Sample Gas Molecular Weight, Wet Basis	lb/lb-mole
Sp	-	Static Pressure of Gas Stream	in. H_2O
Tstd	-	Absolute Standard Temperature (528)	°R
Pstd	-	Absolute Standard Pressure (29.92)	in. Hg
CSA	-	Stack Cross-Sectional Area	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
K1	-	Conversion Factor (13.6)	in. H_2O/in. Hg
K2	-	Conversion Factor (60)	sec/min
Pi	-	Constant (3.1416)	Dimensionless
D	-	Stack Diameter	in.

TEST DATA

Variable	Data	Variable	Data	Variable	Data
Ms =	27.180	Dp =	0.4593	Cp =	0.84
Bws =	0.2009	Pb =	30.11	D =	42.00
Sp =	0.18	Ts =	601.1		

CALCULATIONS

Ps = Pb + (Sp/K1) = 30.11 + (0.18/13.6) = **30.12 in. Hg**

Vs = (Kp)(Cp)(Dp)[(Ts)/(Ms)(Ps)]^0.5

Vs = (85.49)(0.84)(0.4593)[601.1/(27.180)(30.12)]^0.5 = **28.26 ft/sec**

CSA = (Pi)(D^2)/[(4)(144)] = (3.1416)(42.00)^2/[(4)(144)] = **9.62 ft^2**

Qact = (Vs)(CSA)(K2) = (28.26)(9.62)(60) = **16311.7 cfm**

$$Qsd = \frac{(Qact)(1-Bws)(Tstd)(Ps)}{(Ts)(Pstd)} = \frac{(16311.7)(1 - 0.2009)(528)(30.12)}{(601.1)(29.92)}$$

Qsd = **11526.1 dscfm**

FLOW RATE DATA SUMMARY

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable	Definition	Value	Units
	INPUT DATA SUMMARY		
$\%CO_2$	Carbon Dioxide Concentration, Dry Basis	6.80	% Volume
%CO	Carbon Monoxide Concentration, Dry Basis	0.00	% Volume
$\%O_2$	Oxygen Concentration, Dry Basis	10.00	% Volume
$\%N_2$	Nitrogen Concentration, Dry Basis (gas balance)	83.20	% Volume
Pb	Barometric Pressure	30.11	in. Hg
Sp	Static Pressure of Gas Stream	0.18	in. H_2O
Po	Average Meter Differential Pressure	1.56	in. H_2O
Ts	Average Stack Gas Temperature	601.1	°R
Tm	Average Dry Gas Meter Temperature	554.8	°R
Vlcg	Total Condensate Collected	410.5	grams
Vm	Dry Gas Meter Sample Volume	81.140	dcf
DGMC	Dry Gas Meter Correction Factor	0.987	Dimensionless
Dp	Avg. Sq. Root of Velocity Head	0.4593	in. $H_2O^{0.5}$
Cp	Pitot Tube Coefficient	0.84	Dimensionless
D	Stack Diameter	42.00	in.
	RESULTS SUMMARY		
Md	Sample Gas Molecular Weight, Dry Basis	29.488	lb/lb-mole
Ms	Sample Gas Molecular Weight, Wet Basis	27.180	lb/lb-mole
Ps	Absolute Stack Gas Pressure	30.12	in. Hg
Pm	Absolute Dry Gas Meter Pressure	30.22	in. Hg
Vmstd	Dry Gas Meter Sample Volume, at Standard Conditions	76.981	dscf
Vwstd	Volume of Water Vapor Collected, at Standard Conditions	19.355	scf
Bws	Moisture Content	0.2009	mole fraction
Bwd	Moisture Content	20.09	% Volume
CSA	Stack Cross-Sectional Area	9.62	ft^2
Vs	Stack Gas Velocity	28.26	ft/sec
Qact	Volumetric Flow Rate, Wet Basis	16311.7	cfm
Qsd	Volumetric Flow Rate, at Standard Conditions, Dry Basis	11526.1	dscfm
I	Isokinetic Sampling Rate	100.86	%

US EPA ARCHIVE DOCUMENT

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ISOKINETIC SAMPLING DETERMINATION

COMPANY:	**XYZ COMPANY**	**CONDITION:**	**NORMAL**
LOCATION:	**ANYWHERE, USA**	**TEST RUN:**	**ONE**
SOURCE:	**BIF UNIT**		

VARIABLE LIST

Variable			Units
I	-	Isokinetic Sampling Rate	%
Ts	-	Average Stack Gas Temperature	°R
Vmstd	-	Dry Gas Meter Sample Volume, at Standard Conditions	dscf
Vs	-	Stack Gas Velocity	ft/sec
T	-	Sampling Time Duration	minutes
An	-	Cross-Sectional Area of Nozzle	ft^2
Ps	-	Absolute Stack Gas Pressure	in. Hg
Dn	-	Nozzle Diameter	in.
Vlcg	-	Total Condensate Collected	grams
Pi	-	Constant (3.1416)	dimensionless
K1	-	Conversion Factor (144)	in^2/ft^2
K2	-	Conversion Factor (100)	Percent
K3	-	Conversion Factor (17.64)	°R/in. Hg
K4	-	Conversion Factor (0.002669)	$Hg\text{-}ft^3/ml\text{-}°R$
K5	-	Conversion Factor (60)	sec/min

TEST DATA

Variable		Data	Variable	Data	Variable	Data
Vmstd	=	76.981	Ps =	30.12	K2 =	100
Vs	=	28.26	T =	120.0	K3 =	17.64
Vlcg	=	410.5	Dn =	0.312	K4 =	0.002669
Ts	=	601.1	K1 =	144	K5 =	60

CALCULATIONS

An = (Pi)(Dn)^2/[(4)(K1)]

An = (3.1416)(0.312)^2/[(4)(144)] = **0.000531 ft^2**

$$I = \frac{(K2)(Ts)[(Vmstd/K3) + (K4)(Vlcg)]}{(K5)(Vs)(An)(Ps)(T)}$$

$$I = \frac{(100)(601.1)[(76.981/17.64) + (0.002669)(410.50)]}{(60)(28.26)(0.000531)(30.12)(120.0)} = \mathbf{100.86\ \%}$$

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How to Use the Methods 0030 and 0031 Raw Data Calculation Workbook

The Methods 0031and 0030 calculation worksheet was written in Excel. The workbook is comprised of two separate worksheets as follows:

1) Determination of sample gas volume, corrected to standard conditions (Flows)
2) Determination of volatile organic compound mass emission rates (VOC)

The workbook has been protected so that calculations and measurement units associated with each parameter cannot be mistakenly changed by the user. Significient figures for input information and calculation results have been considered and the cells have been formatted to satisfy this requirement. Calculation results that are used in subsequent pages and/or worksheets automatically carry forward in the workbook. Thus, it is imperative that all **red** colored input information is inserted in the specified order.

The font style and size have been configured for Times New Roman 10-point. The workbook will print from most popular HP laser jet printers.

Steps to Use the Methods 0030 and 0031 Workbook

The two worksheets of this workbook must be used in the following order.

Sample Volume Worksheet (Flows)

1) Obtain raw stack test field data and verify/compute average values.
2) Enter plant, location, unit, test condition, and run number. The fields for this information are **red** colored.
3) Input raw field data on page 1. Some of this information will be averaged raw test data, equipment calibration coefficients, and/or single point measurement values. The fields for this information are **red** colored.
4) Review and/or print worksheet.
5) The corrected sample volume is presented on page 2.

Volatile Organic Compound Worksheet (VOC)

1) Obtain raw laboratory data.
2) Input volatile organic contstiuents mass in micrograms on page 1 (total concentration of each constituent in all sample train subsamples). A cell is available for the "<" symbol when the minimum detection limit is used for the value. The fields for this information are **red** colored.
3) Review and/or print worksheet.
4) The results begin on page 2.

RAW DATA INPUT
FOR
EPA METHODS 0030 AND 0031 VOLATILE ORGANICS
PARAMETER LIST FROM SW-846 METHOD 8260A

Plant Name:	XYZ COMPANY
Location:	ANYWHERE, USA
Unit:	BIF UNIT
Condition:	NORMAL
Run No.	ONE

Variable		Definition		Data	Units
Qsd	-	Volumetric Flow Rate, Dry Standard Conditions		42566.3	dscfm
$C_{Chloromethane}$	-	Concentration of Chloromethane	<	2.0	ug
$C_{Vinyl\ Chloride}$	-	Concentration of Vinyl Chloride	<	200.0	ug
$C_{Bromomethane}$	-	Concentration of Bromomethane	<	2.0	ug
$C_{Chloroethane}$	-	Concentration of Chloroethane	<	2.0	ug
$C_{Trichlorofluoromethane}$	-	Concentration of Trichlorofluoromethane	<	2.0	ug
$C_{1,1\text{-}Dichloroethene}$	-	Concentration of 1,1-Dichloroethene	<	2.0	ug
$C_{Carbon\ Disulfide}$	-	Concentration of Carbon Disulfide	<	3.0	ug
$C_{Acetone}$	-	Concentration of Acetone	<	2.0	ug
$C_{Methylene\ Chloride}$	-	Concentration of Methylene Chloride	<	2.0	ug
$C_{trans\text{-}1,2\text{-}Dichloroethene}$	-	Concentration of trans-1,2-Dichloroethene	<	2.0	ug
$C_{1,1\text{-}Dichloroethane}$	-	Concentration of 1,1-Dichloroethane	<	2.0	ug
$C_{cis\text{-}1,2\text{-}Dichloroethene}$	-	Concentration of cis-1,2-Dichloroethene	<	2.0	ug
$C_{Chloroform}$	-	Concentration of Chloroform	<	2.0	ug
$C_{1,2\text{-}Dichloroethane}$	-	Concentration of 1,2-Dichloroethane	<	2.0	ug
$C_{Vinyl\ Acetate}$	-	Concentration of Vinyl Acetate	<	2.0	ug
$C_{2\text{-}Butanone}$	-	Concentration of 2-Butanone	<	2.0	ug
$C_{1,1,1\text{-}Trichloroethane}$	-	Concentration of 1,1,1-Trichloroethane	<	2.0	ug
$C_{Carbon\ Tetrachloride}$	-	Concentration of Carbon Tetrachloride	<	2.0	ug
$C_{Benzene}$	-	Concentration of Benzene	<	2.0	ug
$C_{Trichloroethene}$	-	Concentration of Trichloroethene	<	2.0	ug
$C_{1,2\text{-}Dichloropropane}$	-	Concentration of 1,2-Dichloropropane	<	2.0	ug
$C_{Bromodichloromethane}$	-	Concentration of Bromodichloromethane	<	2.0	ug
$C_{cis\text{-}1,3\text{-}Dichloropropene}$	-	Concentration of cis-1,3-Dichloropropene	<	2.0	ug
$C_{trans\text{-}1,3\text{-}Dichloropropene}$	-	Concentration of trans-1,3-Dichloropropene	<	2.0	ug
$C_{1,1,2\text{-}Trichloroethane}$	-	Concentration of 1,1,2-Trichloroethane	<	2.0	ug
$C_{Dibromochloromethane}$	-	Concentration of Dibromochloromethane	<	2.0	ug
$C_{Bromoform}$	-	Concentration of Bromoform	<	2.0	ug
$C_{4\text{-}Methyl\text{-}2\text{-}Pentanone}$	-	Concentration of 4-Methyl-2-Pentanone	<	2.0	ug
$C_{Toluene}$	-	Concentration of Toluene	<	2.0	ug
$C_{Tetrachloroethene}$	-	Concentration of Tetrachloroethene	<	2.0	ug
$C_{2\text{-}Hexanone}$	-	Concentration of 2-Hexanone	<	2.0	ug
$C_{Chlorobenzene}$	-	Concentration of Chlorobenzene	<	2.0	ug
$C_{Ethylbenzene}$	-	Concentration of Ethylbenzene	<	2.0	ug
$C_{m\text{-}/p\text{-}Xylene}$	-	Concentration of m-/p-Xylene	<	2.0	ug
$C_{o\text{-}Xylene}$	-	Concentration of o-Xylene	<	2.0	ug
$C_{Styrene}$	-	Concentration of Styrene	<	2.0	ug
$C_{1,1,2,2\text{-}Tetrachloroethane}$	-	Concentration of 1,1,2,2-Tetrachloroethane	<	2.0	ug

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VARIABLE LIST		
K1	Conversion Factor (1EE+06)	ug/g
K2	Conversion Factor (60)	s/min

CALCULATIONS

$E_{Chloromethane} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{Vinyl\ Chloride} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<200.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.001850 g/sec**

$E_{Bromomethane} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{Chloroethane} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{Trichlorofluoromethane} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{1,1\text{-}Dichloroethene} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{Carbon\ Disulfide} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<3.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000028 g/sec**

$E_{Acetone} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{Methylene\ Chloride} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{trans\text{-}1,2\text{-}Dichloroethene} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

$E_{1,1\text{-}Dichloroethane} = (C)(Qsd)/(Vmstd)(K1)(K2) = \frac{(<2.0)(42566.3)}{(76.701)(1EE+06)(60)} = <$ **0.000018 g/sec**

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$E_{cis\text{-}1,2\text{-}Dichloroethene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Chloroform}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{1,2\text{-}Dichloroethane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Vinyl\ Acetate}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{2\text{-}Butanone}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{1,1,1\text{-}Trichloroethane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Carbon\ Tetrachloride}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Benzene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Trichloroethene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{1,2\text{-}Dichloropropane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Bromodichloromethane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{cis\text{-}1,3\text{-}Dichloropropene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**

$E_{trans\text{-}1,3\text{-}Dichloropropene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{1,1,2\text{-}Trichloroethane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**

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$E_{Dibromochloromethane}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Bromoform}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{4\text{-Methyl-2-Pentanone}}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Toluene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Tetrachloroethene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{2\text{-Hexanone}}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Chlorobenzene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{Ethylbenzene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{m\text{-/p-Xylene}}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{o\text{-Xylene}}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**

$E_{Styrene}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**
$E_{1,1,2,2\text{-Tetrachloroethane}}$	=	(C)(Qsd)/(Vmstd)(K1)(K2)	=	(<2.0)(42566.3) / (76.701)(1EE+06)(60)	=	<	**0.000018 g/sec**