Consolidated Boiler and Process Heater Emissions Database README

File Last Updated February 5, 2010

Overview:

- This file contains emission test data, fuel analysis data, and continuous emissions monitoring data received through January 15th, 2009. Data received after that point will be reviewed, consolidated, and added to future versions of the emissions database.

- Data from the 2008 U.S. EPA combustion survey has been filtered down to include only emissions and monitoring data from boilers or indirect-fired process heaters at major sources of HAP that are still in operation or expected to be in operation at the boiler MACT rulemaking compliance date. Since fuel analysis data from the Phase I survey was collected on facility basis, only fuel analysis data for major source facilities with a boiler or in-direct fired process heater are included in this database.

- Data from the 2009 U.S. EPA Test Plan includes data from only the boilers or in-direct fired process heaters that were on the test list. A separate database is under development that will contain the results of the Commercial Industrial Solid Waste Incinerators test plan.

- In each data table, there is a column entitled **Data Source**. This field indicates is which phase of the ICR the data represents.
    - "ICR Phase I" – Represents data reported in the 2008 U.S. EPA Combustion Survey (ICR No. 2286.01)
    - "ICR Phase II" – Represents data reported in the 2009 U.S. EPA Test Plan for Boilers, Process Heaters, and Commercial Industrial Solid Waste Incinerators (ICR No. 2286.03). ICR Phase II data is broken down into three sources:
        - Text versions of stack test reports
        - ERG Excel Templates
        - Electronic Reporting Tool (ERT)

- There are nine tables present in the consolidated emissions database. Each table contains data that was reported in the combustion survey as well as data that was standardized so that the data could be analyzed. Each table represents a different type of data:

    - **Data: CEMS –** Represents continuous emissions monitoring data for carbon monoxide (CO), NOx, SO2 and particulate matter (PM). This table contains data reported from ICR Phases I and II.
    - **Data: CO and THC CEMS** – Represents continuous emissions monitoring data for carbon monoxide, methane, non-methane hydrocarbons, and total hydrocarbons. This table contains data from ICR Phase II only.
    - **Data: EmissionsTest** – Represents emissions test data for Dioxin/Furans (both totals and specific congeners); 15-,16-, and 7-PAH; acetaldehyde; antimony; arsenic; benzene; benzo(ghi)perylene; beryllium; cadmium; chlorine; chromium; CO; cobalt; condensable PM; formaldehyde; Hydrogen Chloride; Hydrogen

Fluoride; lead; manganese; mercury; methane; nickel; NOx; filterable PM; PM 10; PM 2.5; total PM (including condensables), Phosphorus; Selenium; SO2; total gaseous non-methane organic compounds (TGNMO), toluene, total hydrocarbons, and xylenes. This table contains data from ICR Phases I and II.

- **Data: Total Metals Emissions** - contains calculated non-mercury total select metals (TSM) emissions for facilities that reported applicable data in ICR Phase II. The following pollutants are the constituents of the TSM values: Antimony (Sb), Arsenic (As), Beryllium (Be), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Lead (Pb), Manganese (Mn), Nickel (Ni), and Selenium (Se). Cobalt emissions were not requested in ICR Phase I, therefore only Phase II metal data was used to calculate TSM. For an emission test that provided emissions data on each of the ten individual metals, the emission values from each of the 10 metals were summed for each test run. If some metals were reported as non-detect, the reported in-stack detection level was used in the sum.
- **Data: Total PCDD/PCDF Emissions (TEQ & Total Mass)** - contains both total mass and toxic-equivalent (TEQ) PCDD/PCDF emissions from ICR Phase II. Data was reported on a total mass basis. If a facility reported total PCDD/PCDF emissions for a test, those values were used to develop a unit-specific total mass average. If no total value was reported, the sum of the individual cogeners for each run was used to calculate a total mass value. TEQ PCDD/PCDF emissions were calculated by multiplying the emission values of 17 selected cogeners by the corresponding toxic equivalency factors developed by the World Health Organization in 2005. Occasionally total TEQ values were reported, these were not used to evaluate the floors since there was no documentation was provided on what factors were used. These factors may be found in the **LOOKUP: Toxic Equivalency Factors** table.
- **Data: FuelAnalysis** – Represents fuel analysis data for moisture, higher heating value, antimony, arsenic, beryllium, cadmium, chlorine, chromium, cobalt, fluorine, lead, manganese, mercury, nickel, nitrogen, phosphorus, selenium, sulfur. This table contains data from ICR Phases I and II.
- **Data**: **Facility** – Contains a list of facility-level information for major source facilities with boilers or indirect-fired process heaters. This table contains data from ICR Phase I.
- **LOOKUP**: **ET Fuel F-Factors** – Contains the fuel-specific F-factors used to standardize emissions data from concentrations to a lb/mmBtu format.
- **LOOKUP: Toxic Equivalency Factors** – Contains the 2005 World Health Organization toxic equivalency factors used to estimate TEQ PCDD/PCDF emissions.

- Each of the tables contains a brief definition of the data contained in each field of the data table.

ICR Phase II Data Hierarchy:

- Some of the phase II data were reported using multiple methods. To avoid duplicate data in the consolidated emissions database, a hierarchical approach for each pollutant was used to determine which data was incorporated into the consolidated database:

1. When both hard copy or electronic .pdf copy of a test report summary and either the ERT or ERG Excel spreadsheet templates were provided, the electronically available data from the ERT and Excel spreadsheet templates were used in the consolidated emissions database to minimize data entry and processing time.
2. When both ERG Excel Template data and an ERT project dataset both contained data for the same pollutant, the ERG Excel template was added to the consolidated emissions database. The **Data Source** field is populated with "ICR Phase II – Templates" for this type of data.
3. If no ERG Excel Template data was provided for a pollutant ERT data was added to the consolidated emissions database. The **Data Source** field is populated with "ICR Phase II – ERT" for this type of data.
4. After the data from the ERT and ERG templates were consolidated, any pollutants with negative or zero reported values or expected outliers for high or low emission rates were compared to the hard copy and electronic .pdf files to confirm these questionable values. If the test report had values that differed from the ERT or ERG templates, the data from these test reports replaced the ERT and ERG template data in the consolidated database. The reported emissions data for each unit on the test list were also reviewed for any pollutants not reported in the ERT or ERG templates. These data gaps reviewed to determine if fuel analysis data were used in lieu of stack testing or if EPA had granted a testing waiver for certain pollutants. If the data were actually missing, the stack test reports were reviewed, and used to populate the database. If a test report was used as the basis for the consolidated emission database the **Data Source** field is populated with "ICR Phase II - Test Report" for this type of data.
5. Particulate matter was handled on a unit-specific basis for ICR Phase II.
    - There are five types of particulate matter reported in this database: filterable PM, condensable PM, total PM (including condensables), PM less than 10 microns (PM10), and PM less than 2.5 microns (PM2.5).
    - The majority of the total PM (including condensables) data is from Phase I of the ICR; it was not asked for on the ERG Phase II spreadsheet templates but it could have been reported in the ERT.
    - If ERG Phase II template data was provided for filterable, condensable, and PM2.5, then no ERT PM data was included in the consolidated database.
    - For all types of PM data that were not reported in the ERG Phase II templates, the ERT data for that specific type of PM was included. For example, ALIPCourtland reported filterable and condensable PM in the templates, but not PM2.5. Thus, that facility's ERT data for PM2.5 is included in the consolidated database. As specified by the hierarchy, the outlying data points were checked against the test reports and any inconsistent data was replaced with the values reported in the test reports.

- Only one set of data was used per combustion unit per pollutant for the ICR Phase II data. Thus, if a facility submitted ERT and ERG template data for CO, the hierarchy states that the template data would have been used over the ERT data. Test runs for the same

pollutant were not mixed between different data sources. There are five exceptions to this:

- INNotreDame, TNInvistaChattanooga, and VAINVISTAWaynesboro reported individual PCDD/PCDF cogener data in the ERG templates. Data for 'Total HpCDD', 'Total HpCDF', 'Total HxCDD', 'Total HxCDF', 'Total PeCDD', 'Total PeCDF', 'Total TCDD', and 'Total TCDF' were entered in the ERT templates. TNInvistaChattanooga reported all individual PCDD/PCDF cogeners but one in the ERG templates—the ERT data reported for '1,2,3,7,8,9 HxCDF'.
- MDSeverstalSparrows conducted two separate tests for CO emissions, for a total of 6 runs. Three of these runs are reported in the ERT templates and three of these runs are reported in the stack test report. The ERT data reported for 'Total OCDF' and '1,2,3,4,7,8 HxCDF'
- ORFlakeboardEugene were compared to their hard copy test report submittal. Data from the test report was entered for run 2 '1,2,3,4,7,8 HxCDF' and run 3 of 'Total OCDF'.

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Notes on Data Standardizations:

Emission Data

- Equations used to standardized emissions data are contained in Appendices A-1 and A-2 of this document. The equation identifier "EQID" listed in the Appendix matches the identifier noted in the database for each record. A note is also provided if emission data could not be standardized.

- ERT data for condensable PM was reported in organic and inorganic fractions. To analyze total condensable PM, a total condensable particulate matter number was calculated by summing the organic and inorganic fractions. The **Parameter Name**, **SourceTab**, and **Sample Half** fields indicate what fraction is represented by each row of condensable PM data. The organic and inorganic condensable PM fractions reported in the ERT are retained in the **Data: EmissionsTest** table.

- Some facilities reported metallic HAP emissions as total metallic HAP while others reported the front and back half portions of metallic HAP emissions separately. To analyze total metallic HAP emissions, a total was calculated for each metal by summing the front and back half values. The **Parameter Name**, **SourceTab**, and **Sample Half** fields indicate what types of metal data are represented in each by each row of the metallic HAP data. The front-half and back-half metallic HAP emissions reported in the ERT or ERG templates are retained in the **Data: EmissionsTest** table.

- Since the ERT does not track multiple fuel input rates or control devices used during each test run, it was assumed that the fuel and control data between ERT and ERG template data were the same. If a facility submitted emission test results in both the ERT and ERG templates, the fuel(s) and control(s) used during the reported ERT test results were assumed to be identical to the fuel and control data reported in the ERG templates. If the ERG templates did not provide fuel and control data, or if the facility did not submit any

ERG emission test templates as part of its Phase II test response, the reported test results were assigned to the fuel and control data reported for that unit ICR Phase I survey. For several facilities with outlying emission test data, since the test report was already being reviewed for emissions the fuel and control information were reviewed in the test report document confirm the fuels and controls installed during the tests.

Fuel Data

- Appendix B maps each of the fuels reported in the Phase I survey and Phase II testing to various fuel categories. These fuel categories are used to estimate baseline emissions. For the purposes of analyzing the floor, wet, dry biomass and bagasse will all be grouped into a biomass category. Heavy and light liquid fuels will be grouped together into a liquid fuel category.

Combustor Design

- Appendix C outlines the combustor design classifications for the various designs reported during the Phase I survey. It also lays out the combustor design assignments when multiple combustor designs were reported in the survey. The combustor design was obtained from the table Data: Unit Design and Operations, based on responses to survey questions Part II.B.1.l, Part II.B.1.m, and Part II.B.1.n.
- If emission data reflect emissions from more than one boiler or process heater sharing a common stack the combustor design of each unit feeding the stack was reviewed. If both units had the same combustor design and were in the same fuel category, the combustor design for that emission test data was assigned to combustor design reported for each of the units feeding the stack. If the units feeding the stack had different combustor designs, or were in different fuel categories, the combustor design category column would read "Multiple Combustor Designs".
- If emission data reflect emissions from both a boiler or process heater and another combustion device that is not part of the source category regulated under 40 CFR Part 63 DDDDD, a note was added to the "Note" field to indicate the emissions reflect data from more than one type of combustion device.

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
µg/dscf[1]	Metals & PM	CEq1	* (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
ppm (wet)[1]	Non-metals	CEq2	* ((100-RunMoisture%)/100)) * (1000 ppb/ppm) * ((20.946-3)/20.946)	ppb @ 3% O2
ppmw[2]	Non-metals	CEq3	* (1/10^6) * ((1.205 g/cm^3 air)/(1.528 g/cm^3 HCl)) * (10^9) * ((20.946-3)/20.946)	ppb @ 3% O2
ppb[1]	Non-metals	CEq4	* ((20.946-3)/20.946)	ppb @ 3% O2
µg/L[1]	Metals & PM	CEq5	* (1000 L/dscm) * ((459.67+RunExhaustTemp (F)) / (459.67+68)) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
gr/dscf @ 10% O2	Metals & PM	CEq6	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/(20.946 - 10))	µg/dscm @ 3% O2
gr/dscf @ 8% O2	Metals & PM	CEq7	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/(20.946-8))	µg/dscm @ 3% O2
gr/dscf[1]	Metals & PM	CEq8	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
grains/dscf @ 50% excess air[1]	Metals & PM	CEq9	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
grams/ft^3[1,3]	Metals & PM	CEq10	* (1000000 µg/g) * (35.315 dscf/dscm) * (459.67+RunExhaustTemp (F)/459.67+68)) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
µg/dscm @ 7% O2	Metals & PM	CEq11	* ((20.946-3)/(20.946-7))	µg/dscm @ 3% O2
µg/dscm[1]	Metals & PM	CEq12	* ((20.946-3)/20.946)	µg/dscm @ 3% O2
Vol %	Non-metals	CEq13	* (100/1000000000) * ((20.946-3)/(20.946-RunO2(%))	ppb @ 3% O2
ppm @ 3% O2	Non-metals	CEq14	* (1000 ppb/ppm)	ppb @ 3% O2
ppm; ppm (dry)[1]	Non-metals	CEq15	* (1000 ppb/ppm) * ((20.946-3)/20.946)	ppb @ 3% O2
ppm @ 15% O2	Non-metals	CEq16	* (1000 ppb/ppm) * ((20.946-3)/(20.946-15))	ppb @ 3% O2

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
ppm @ 4.2% O2	Non-metals	CEq17	* (1000 ppb/ppm) * ((20.946-3)/(20.946-4.2))	ppb @ 3% O2
ppm @ 4.7% O2	Non-metals	CEq18	* (1000 ppb/ppm) * ((20.946-3)/(20.946-4.7))	ppb @ 3% O2
ppm @ 7% O2	Non-metals	CEq19	* (1000 ppb/ppm) * ((20.946-3)/(20.946-7))	ppb @ 3% O2
ppm @ 8% O2	Non-metals	CEq20	* (1000 ppb/ppm) * ((20.946-3)/(20.946-8))	ppb @ 3% O2
ppm; ppm (dry)	Non-metals	CEq21	* (1000 ppb/ppm) * ((20.946-3)/20.946-RunO2(%))	ppb @ 3% O2
mg/dscm @ 7% O2	Metals & PM	CEq22	* (1000 µg/mg) * ((20.946-3)/(20.946-7))	µg/dscm @ 3% O2
µg/dscm @ 7% O2	Non-metals	CEq23	* (1/1000000 g/µg) * (1/MW mol/g) * (1/22.4 dsL/mol) * (0.001 m^3/L) * (10^9) * ((20.946-3)/(20.946-7))	ppb @ 3% O2
ppm[l]	Metals & PM	CEq24	* (1/10^6) * (22.4 mol/dsL) * (1000 L/m^3) * (MW g/mol) * (10^6) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
ppm @ 18.25% O2	Non-metals	CEq25	* (1000 ppb/ppm) * ((20.946-3)/(20.946-18.25))	ppb @ 3% O2
ppm @ 18.40% O2	Non-metals	CEq26	* (1000 ppb/ppm) * ((20.946-3)/(20.946-18.40))	ppb @ 3% O2
g/dscm[4]	Metals & PM	CEq27	* (1000000 µg/g) * ((20.946-3)/(20.946-7))	µg/dscm @ 3% O2
grains/acf[l]	Metals & PM	CEq28	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * ((459.67+RunExhaustTemp (F))/(459.67+68)) * ((20.946-3)/20.946) * (35.315 dscf/dscm)	µg/dscm @ 3% O2
grains/dscf @ 7%O2	Metals & PM	CEq29	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/(20.946-7))	µg/dscm @ 3% O2
grains/dscf @ 12% CO2	Metals & PM	CEq30	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/(20.946-12))	µg/dscm @ 3% O2
lb/dscf[l]	Metals & PM	CEq31	* (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
lb/dscf*10^-6[l]	Metals & PM	CEq32	* (10^6) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
mg/dscm[1]	Metals & PM	CEq33	* (1000 µg/mg) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
µg/dscm[1]	Non-metals	CEq34	* (1/1000000 g/µg) * (1/MW mol/g) * (1/22.4 dsL/mol) * (1/1000 m^3/L) * (10^9) * ((20.946-3)/20.946)	ppb @ 3% O2
lb/dscf[1]	Non-metals	CEq35	* (453.59 g/lb) * (1/MW mol/g) * (1/22.4 dsL/mol) * (1/28.32 ft^3/L) * (10^9) * ((20.946-3)/20.946)	ppb @ 3% O2
lb/MMCF[1,5]	Non-metals	CEq36	* (1/10^6 mmscf/scf) * (453.59 g/lb) * (1/MW mol/g) * (1/22.4 dsL/mol) * (1/28.32 10ft^3/L) * (10^9) * ((20.946-3)/20.946)	ppb @ 3% O2
mg/dscm @ 7% O2	Non-metals	CEq37	* (1/1000 g/mg) * (1/MW mol/g) * (1/22.4 dsL/mol) * (1/1000 m^3/L) * (10^9) * ((20.946-3)/(20.946-7))	ppb @ 3% O2
ppm @ 4%O2	Non-metals	CEq39	* (1000 ppb/ppm) * ((20.946-3)/(20.946-4))	ppb @ 3% O2
ppm @ 15% O2	Non-metals	CEq40	* (1000 ppb/ppm) * ((20.946-3)/(20.946-15))	ppb @ 3% O2
ppm @ 3.5% O2	Non-metals	CEq41	* (1000 ppb/ppm) * ((20.946-3)/(20.946-3.5))	ppb @ 3% O2
µg/dscm @ 3% O2	Non-metals	CEq42	* (1/1000000 g/µg) * (1/MW mol/g) * (1/22.4 dsL/mol) * (1/1000 m^3/L) * (10^9)	ppb @ 3% O2
ng/dscm	Metals & PM	CEq44	* (1/1000 µg/ng) * ((20.946-3)/(20.946-7))	µg/dscm @ 3% O2
ppm @ 10.3% O2	Non-metals	CEq45	* (1000 ppb/ppm) * ((20.946-3)/(20.946-10.3))	ppb @ 3% O2
ppb @ 3% O2	Non-metals	CEq46	1	ppb @ 3% O2
pg/dscf[1]	Metals & PM	CEq47	* (1/1000000 µg/pg) * ((20.946-3)/20.946) * (1/0.028316847 ft^3/m^3)	µg/dscm @ 3% O2
mg/Nm^3 @ 10%O2	Metals & PM	CEq48	* (1000 µg/mg) * ((20.946-3)/(20.946-10))	µg/dscm @ 3% O2
ng/dscm[1]	Metals & PM	CEq51	* (1/1000 µg/ng) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
ug/ml[1]	Non-metals	CEq52	* (1/1000000 g/µg) * (1/MW mol/g) * (22.4 dsL/mol) * (1000 mL/L) * (1000000000 ppb) * ((20.946-3)/20.946)	ppb @ 3% O2

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
ppm @ 3% O2	Non-metals	CEq53	* (1000 ppb/ppm)	ppb @ 3% O2
ppm	Non-metals	CEq54	* (1000 ppb/ppm) * ((20.946-3)/(20.946-O2 Correction %))	ppb @ 3% O2
ppmvd @ 7% O2	Non-metals	CEq56	* (1000 ppb/ppm) * ((20.946-3)/(20.946-7))	ppb @ 3% O2
percent[1]	Metals & PM	CEq58	* (1/100 parts/%) * (1000000 ppm/parts) * (MW g/mol) * (1/22.4 mol/dsL) * (1000 dsL/dscm) * (1000000 µg/g) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
gr/dscm[1]	Metals & PM	CEq59	* (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
ppm (wet) @ 10% O2	Non-metals	CEq60	* ((100-RunMoisture%)/100) * (1000 ppb/ppm) * ((20.946-3)/(20.946-10))	ppb @ 3% O2
ppm @ 12% CO2	Non-metals	CEq61	* (1000 ppb/ppm) * ((20.946-3)/(20.946-12))	ppb @ 3% O2
ppm @ 10% O2	Metals & PM	CEq62	* (1/1000000 1/ppm) * (1/22.4 mol/dsL) * (1000 L/m^3) * (MW g/mol) * (1000000 µg/g) * ((20.946-3)/(20.946-10))	µg/dscm @ 3% O2
mg/dscm @ 10% O2	Metals & PM	CEq63	* (1000 µg/mg) * ((20.946-3)/(20.946-10))	µg/dscm @ 3% O2
mg/dscm @ 10% O2	Non-metals	CEq64	* (g/1000 mg) * (1/MW mol/g) * (22.4 dsL/mol) * (1/1000 m3/L) * (1000000000 ppb) * ((20.946-3)/(20.946-10))	ppb @ 3% O2
gr/dscf @ 3% O2	Metals & PM	CEq65	* (lb/7000 gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm)	µg/dscm @ 3% O2
gr/dscf @ 6% O2	Metals & PM	CEq66	* (lb/7000 gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/(20.946-6))	µg/dscm @ 3% O2
Weight %	Non-metals	CEq67	* (1/100 parts/%) * (1000000000 ppb/parts) * ((20.946-3)/(20.946-RunO2(%))	ppb @ 3% O2
grains/100 dscf[1]	Metals & PM	CEq68	* (1/100 1/dscf) * (1/7000 lb/gr) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
ppm @ 10% O2	Non-metals	CEq69	* (1000 ppb/ppm) * ((20.946-3)/(20.946-10))	ppb @ 3% O2

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
ng/dscm @ 10% O2	Dioxins/Furans	CEq70	* ((20.946-7)/(20.946-10))	ng/dscm @ 7% O2
ng/dscm[1]	Dioxins/Furans	CEq71	* ((20.946-7)/20.946)	ng/dscm @ 7% O2
gr/dscf@7% O2	Dioxins/Furans	CEq72	* (lb/7000 gr) * (453.59 g/lb) * (1000000000 ng/g) * (35.315 dscf/dscm)	ng/dscm @ 7% O2
gr TEQ/dscf @ 7% O2	Dioxins/Furans	CEq73	* (lb/7000 gr) * (453.59 g/lb) * (1000000000 ng/g) * (35.315 dscf/dscm)	TEQ ng/dscm @ 7% O2
gr/dscf TEQ[1]	Dioxins/Furans	CEq74	* (lb/7000 gr) * (453.59 g/lb) * (1000000000 ng/g) * (35.315 dscf/dscm) * ((20.946-7)/20.946)	TEQ ng/dscm @ 7% O2
TEQ (ng/dscm @ 7% O2)	Dioxins/Furans	CEq75	1	TEQ ng/dscm @ 7% O2
TEQ ng/dscmNot incl. NDs or EMPCs[1]	Dioxins/Furans	CEq76	* ((20.946-7)/20.946)	TEQ ng/dscm @ 7% O2
TEQ ng/dscm @10% O2Not incl. NDs or EMPCs	Dioxins/Furans	CEq77	* ((20.946-7)/(20.946-10))	TEQ ng/dscm @ 7% O2
PCDD/PCDF (ng/dscm @ 7% O2)	Dioxins/Furans	CEq78	1	PCDD/PCDF ng/dscm @ 7% O2
lb/MMcf[d]	Metals & PM	CEq79	* (1/1000000 mmscf/scf) * ((459.67+RunExhaustTemp(F))/(459.67+68)) * (453.59 g/lb) * (1000000 µg/g) * (35.315 dscf/dscm) * ((20.946-3)/20.946)	µg/dscm @ 3% O2
µg/dscm @ 3% O2	Metals & PM	CEq80	1	µg/dscm @ 3% O2
mg/NM3	Non-metals	CEq81	* (g/1000 mg) * (1/MW mol/g) * (22.4 dsL/mol) * (1/1000 m3/L) * (1000000000 ppb) * ((20.946-3)/(20.946-O2%))	ppb @ 3% O2
mg/Nm3 @10%O2	Non-metals	CEq82	* (g/1000 mg) * (1/MW mol/g) * (22.4 dsL/mol) * (1/1000 m3/L) * (1000000000 ppb) * ((20.946-3)/(20.946-10))	ppb @ 3% O2
ng/dscm @ 7% O2	Dioxins/Furans	CEq84	1	ng/dscm @ 7% O2
ppb	Non-metals	CEq85	((20.946-3)/20.946-RunO2(%))	ppb @ 3% O2

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
lb/Trillion Btu	All pollutants	HI1	* (1/1000000 tBtu/mmBtu)	lb/MMBtu
g/bhp-hr[6]	All pollutants	HI2	* (0.00009174 g/bhp-hr / lb/MMbtu)	lb/MMBtu
lb/1000lb steam	All pollutants	HI3	* (1/1000 klb/lb) * (1/1150 lb steam/Btu) * (1000000 Btu/mmBtu)	lb/MMBtu
lb/MMBtu	All pollutants	HI4	1	lb/MMBtu
mg/hr	All pollutants	HI5	* (1/1000 g/mg) * (1/453.59 lb/g) / Heat Input (mmBtu/hr)	lb/MMBtu
g/hr	All pollutants	HI6	* (1/453.59 lb/g) / Heat Input (mmBtu/hr)	lb/MMBtu
lb/day[8]	All pollutants	HI7	* (1/24 day/hr) / Heat Input (mmBtu/hr)	lb/MMBtu
lb/hr	All pollutants	HI8	* (1/Heat Input (MMBtu/hr))	lb/MMBtu
ton/yr	All pollutants	HI9	* (2000/(OperationHours*Heat Input (MMBtu/hr)))	lb/MMBtu
lb/1000lb exhaust gas[7]	All pollutants	HI10	* (exhaust flowrate (dscfm)) * (60 min/hr) * ((0.075 lb/ft^3)/(1000 lb air*Heat Input (MMBtu/hr)))	lb/MMBtu
g/sec	All pollutants	HI20	* (3600 sec/hr) / (Heat Input (MMBtu/hr)*453.59 g/lb)	lb/MMBtu
lb/yr	All pollutants	HI21	* (1/(OperationHours*Heat Input (MMBtu/hr))	lb/MMBtu
mg/min	All pollutants	HI22	* (0.0000022 lb/mg) * (60 min/hr) / (Heat Input (MMBtu/hr))	lb/MMBtu
kg/hr	All pollutants	HI23	* (2.2 lb/kg) / (Heat Input (MMBtu/hr))	lb/MMBtu
TEQ lb/hr	Dioxins/Furans	HI24	* (1/Heat Input (MMBtu/hr))	TEQ lb/MMBtu
sum of 2,3,7,8-TCDD TEQ ug/hr including 1/2 D.L.	Dioxins/Furans	HI25	* (1/1000000 g/ug) * (1/453.59 lb/g) / Heat Input (mmBtu/hr)	2,3,7,8-TCDD TEQ lb/MMBtu

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
tons/day[8]	All pollutants	HI26	* (2000 lb/ton) * (1/24 day/hour) / Heat Input (mmBtu/hr)	lb/MMBtu
lb./1000lbs.wet gas @50% E.A.	All pollutants	HI27	* (Exhaust Flowrate (dscfm)) * (60 min/hr) * (0.075 lb/ft^3) / (1000 lb air * Heat Input (mmBtu/hr)) * ((100-RunMoisture%) / 100)	lb/MMBtu
g/day[8]	All pollutants	HI28	* (1/24 day/hr) * (1/453.59 lb/g) / Heat Input (mmBtu/hr)	lb/MMBtu
kg/day[8]	All pollutants	HI29	* (1/24 day/hr) * (1000 g/kg) * (1/453.59 lb/g) / Heat Input (mmBtu/hr)	lb/MMBtu
ton/month[9]	All pollutants	HI30	* (1/30 month/day) * (1/24 day/hr) * (2000 lb/ton) / Heat Input (mmBtu/hr)	lb/MMBtu
grains/day[8]	All pollutants	HI31	* (1/24 day/hr) * (1/7000 lb/gr) / Heat Input (mmBtu/hr)	lb/MMBtu
lb/month[9]	All pollutants	HI32	* (1/30 mo/day) * (1/24 day/hr) / Heat Input (mmBtu/hr)	lb/MMBtu
tons/hr	All pollutants	HI33	* (2000 lb/ton) / H.I. (mmBtu/hr)	lb/MMBtu
g/sec	All pollutants	HI34	* (3600 sec/hr) * (1/453.59 lb/g) / H.I. (mmBtu/hr)	lb/MMBtu
lb/MW-hr	All pollutants	HI35	* (0.29307 MW-hr/MMBtu)	lb/MMBtu
lb/3-hour	All pollutants	HI36	* (1/3 1/hr) * (1 / H.I. (mmBtu/hr))	lb/MMBtu
lb/hr (TEQ)	Dioxins/Furans	HI37	1 / H.I. (mmBtu/hr)	TEQ lb/MMBtu
PCDD/PCDF Tons/year	Dioxins/Furans	HI38	* (2000 lb/ton) / (OperationHours * H.I. (in mmBtu/hr))	PCDD/PCDF lb/MMBtu
sum of 2,3,7,8-TCDD TEQ ug/hr including 1/2 D.L.	Dioxins/Furans	HI39	* (1/1000000 g/ug) * (1/453.59 lb/g) * (1/H.I. (mmBtu/hr))	TCDD lb/MMBtu
lbs/hr PCDD/PCDF TEQ	Dioxins/Furans	HI40	1 / H.I. (mmBtu/hr)	PCDD/PCDF lb/MMBtu
lb/hr 2,3,7,8-TCDD Equivalents	Dioxins/Furans	HI41	1 / H.I. (mmBtu/hr)	TCDD lb/MMBtu

Appendix A-1: Conversion Equations Used to Standardize Reported Emission Data

Reported Emission Units	Associated Pollutants[a]	EQ ID	Conversion Equation	Resulting Converted Emission Units
lb/MMBtu	Metals & PM	FF1[10]	1	lb/MMBtu
ppb @ 3% O2	Metals & PM	FF2[10]	* (1/1000000000 1/ppb) * (MW lb/lb-mole) * (1/385.34 lb-mol/dscf) * (F-Factor dscf/mmBtu) * (20.946/(20.946-3))	lb/MMBtu
µg/dscm @ 3% O2	Metals & PM	FF3[10]	* (1/1000000 g/µg) * (1/453.59 lb/g) * (1/35.315 dscm/dscf) * (F-Factor dscf/mmBtu) * (20.946/(20.946-3))	lb/MMBtu
lb/MMBtu[1]	Non-metals	FF4[10]	* (1/F-Factor mmBtu/dscf) * (1/MW lb-mole/lb) * (385.34 dscf/lb-mole) * ((20.946-3)/20.946) * (1000000 ppm)	ppm @ 3% O2
ppb @ 3% O2	Non-metals	FF5[10]	* (1/1000 ppm/ppb)	ppm @ 3% O2
µg/dscm @ 3% O2	Non-metals	FF6[10]	* (1/1000000 g/µg) * (1/MW mol/g) * (22.4 dsL/mol) * (1/1000 dscm/L) * (1000000 ppm)	ppm @ 3% O2
ng/dscm @ 7% O2	Dioxins/Furans	FF7[10]	1	ng/dscm @ 7% O2
lb/MMBtu[1]	Dioxins/Furans	FF8[10]	* (453.59 g/lb) * (1000000000 ng/g) * (1/F-Factor mmBtu/dscf) * (35.315 dscf/dscm) * ((20.946-7)/20.946)	ng/dscm @ 7% O2

NOTES:

a. Generally, pollutants that are emitted as gases (i.e., CO, organic HAP and acid gases) are reported on a relative basis, such as volume of pollutant per volume of stack gas. Pollutants that are emitted as solids or particulate matter are reported on an absolute basis, such as mass of pollutant per volume of stack gas. Therefore the process for standardizing these two types of data, when reported as concentrations, was handled separately. Metals and PM data reported as concentrations were standardized to a single concentration in units of µg/dscm @ 3% O2. Organic HAP, CO and acid gases reported as concentrations were standardized to a single concentration in units of ppm@ 3 % O2.

[1] For emission test data reported in the survey, if O_2 adjustment was not reported, it was estimated to be zero for all pollutants except for CO. For CO, a standardized value was not calculated unless the O2 level was reported during the emission test. For CEMS data, data was only converted when the CEMS measurements included an O2 correction. For all data reported in the phase II test data, the values were converted only when oxygen corrections were provided. Most of the phase II test data did not require these conversions since emission data was requested using a single unit of measure.

[2] Assumed ppmw is ppm by weight at standard conditions; density of air assumed to be roughly equivalent to density of exhaust stream.

[3] Assumed cubic feet of exhaust flow volume were reported at dry standard conditions when not otherwise specified.

[4] Individual test files were reviewed and emissions were reported at 7% O_2.

[5] Assumed MMCF is million cubic feet at actual conditions.

[6] Assumed 85% boiler efficiency.

[7] Assumed 1000 lbs exhaust gas is dry exhaust; density of air at dry conditions is 0.075 lb/ft^3.

[8] Assumed one day is equivalent to 24 hours of operating time and nothing less.

[9] Assumed one month is equivalent to 30 days of operating time and nothing less.

[10] To convert PM, metals, and acid gas data reported in concentrations data from their standardized concentrations to an emission rate, and to convert CO, NOx, and other organic HAP data from emission rates to concentrations we applied F-factors to relate exhaust volumes to fuel energy inputs during the tests. The 8 conversion equations in Appendix A-1 of this document with the prefix "FF" call an F-factor into the conversion equation to standardize the data. F-Factors themselves are fuel-specific. A unique F-Factor was assigned to each emission test based on the fuel reported during the test, and that value was used in the standardization of the reported data. A list of all F-Factors used in converting emission test and CEM data (and the sources from which the F-Factors were found) can be found in the *LOOKUP: ET Fuel F-Factors* database table. If an emission test reported combusting more than one type of fuel during the test, an average of the F-Factors for each fuel type in the mix were used. If an emission test reported a fuel for which no F-Factor could be found, the data points corresponding to that fuel were not standardized in this step. Similarly, if an emission test reported a fuel combination and one or more of the constituent fuels had no F-Factor assigned, only the fuels with known F-Factors were averaged to get the final value.

Appendix A-2: Standardization of Total Hydrocarbon Emission Concentrations to Parts Per Million as Propane

Reported Pollutant Basis	Test Method	Conversion Factor for Emission Concentration	Standardized Pollutant Basis
THC as Propane	EPA Method 25A	1	THC as Propane
THC as Methane	EPA Method 18	0.333	THC as Propane
THC as Carbon	EPA Method 25A	1.22	THC as Propane

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Bagasse	Bagasse
Bagasse/Wood: Unadulterated Lumber	Bagasse
Coal: Bituminous	Coal
Coal: Bituminous/Biogas	Coal
Coal: Bituminous/Biomass/Biogas	Coal
Coal: Bituminous/Coal: Sub-bituminous	Coal
Coal: Bituminous/Coal: Sub-bituminous/ Natural gas/No. 2 Distillate	Coal
Coal: Bituminous/Coke Oven Gas	Coal
Coal: Bituminous/Glycerol Distillation Byproduct/Natural gas	Coal
Coal: Bituminous/Hog Fuel/Industrial Sludge/Natural gas/Wood: Plywood, Particleboard (containing glues or resins)	Coal
Coal: Bituminous/Natural gas	Coal
Coal: Bituminous/Natural gas/ No. 2 Distillate	Coal
Coal: Bituminous/Natural gas/ Plant-based Agricultural Residue/ Tire Derived Fuel (TDF)/Wood: Bark	Coal
Coal: Bituminous/No. 2 Distillate	Coal
Coal: Bituminous/No. 6 Residual Oil	Coal
Coal: Bituminous/Petroleum Coke	Coal
Coal: Bituminous/Tire Derived Fuel (TDF)/ Wood: Unadulterated Timber	Coal
Coal: Bituminous/Wood: Bark	Coal
Coal: Bituminous/Wood: Bark/ Industrial Sludge	Coal

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Coal: Bituminous/Wood: Unadulterated Lumber/Wood: Plywood, Particleboard (containing glues or resins)	Coal
Coal: Sub-bituminous	Coal
Coal: Sub-bituminous/Natural gas	Coal
Coal: Sub-bituminous/ Plant-based Agricultural Residue	Coal
Petroleum Coke	Coal
Biomass	Dry Biomass
Biomass (off-site)/Screen Rejects	Dry Biomass
Cellulose fuel (balcones cubes)	Dry Biomass
Deinking Residuals/ Wood: Unadulterated Lumber	Dry Biomass
Hog Fuel	Dry Biomass
Hog Fuel/Hydro pulper refuse/ Industrial Sludge	Dry Biomass
Hog Fuel/Natural gas	Dry Biomass
Hog Fuel/Natural gas/Noncondensable Gas (includes stripper offgas)	Dry Biomass
Hog Fuel/Natural gas/Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Hog Fuel/Plant-based Agricultural Residue	Dry Biomass
Hog Fuel/Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Hog Fuel/Wood: Unadulterated Lumber	Dry Biomass
Industrial Sludge/Hog Fuel	Dry Biomass
MDF Scraps	Dry Biomass
Natural gas/Plant-based Agricultural Residue	Dry Biomass

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Natural gas/Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Natural gas/Wood: Unadulterated Lumber	Dry Biomass
Natural gas/Wood: Unadulterated Lumber	Dry Biomass
No. 2 Distillate/Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
No. 2 Distillate/Wood: Unadulterated Lumber/Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Plant-based Agricultural Residue	Dry Biomass
Plant-based Agricultural Residue/ Hog Fuel	Dry Biomass
Plant-based Agricultural Residue/Wood: Treated/Wood: Unadulterated Lumber	Dry Biomass
Plant-based Agricultural Residue/ Wood: Unadulterated	Dry Biomass
Plywood Sander Dust	Dry Biomass
Resin Solid Residues/Oily Wood/ Paper and Paper Residues/ Wood: Unadulterated Lumber	Dry Biomass
Tire Derived Fuel (TDF)/ Wood: Unadulterated Lumber	Dry Biomass
Wood: Engineered Pellets	Dry Biomass
Wood: Painted or Varnished	Dry Biomass
Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Wood: Plywood, Particleboard (containing glues or resins)/Natural gas	Dry Biomass
Wood: Plywood, Particleboard (containing glues or resins)/Natural gas/ Industrial Sludge/Hydro pulper refuse	Dry Biomass
Wood: Plywood, Particleboard (containing glues or resins)/Wood: Unadulterated Lumber	Dry Biomass
Wood: Treated/ Wood: Undadulterated Lumber	Dry Biomass

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Wood: Unadulterated/ Wood: Adulterated/Industrial Sludge/ Hydro pulper refuse/Natural gas	Dry Biomass
Wood: Unadulterated Lumber	Dry Biomass
Wood: Unadulterated Lumber/ Ground Toilet Seats	Dry Biomass
Wood: Unadulterated Lumber/Natural gas/Industrial Sludge/Hydro pulper refuse	Dry Biomass
Wood: Unadulterated Lumber/ Other Petroleum-based Oils	Dry Biomass
Wood: Unadulterated Lumber/ Screen Rejects	Dry Biomass
Wood: Unadulterated Lumber/ Wood: Plywood, Particleboard (containing glues or resins)	Dry Biomass
Hydrogen	Gas 1
Hydrogen/CO2	Gas 1
Hydrogen/Natural gas	Gas 1
LPG	Gas 1
LPG/Natural gas	Gas 1
LPG/Natural gas/Refinery gas	Gas 1
Natural gas	Gas 1
Natural gas/Propane	Gas 1
Natural gas/Refinery Gas	Gas 1
Pilot Gas	Gas 1
Pilot Gas/Refinery gas	Gas 1
Process gas/Natural gas	Gas 1
Propane	Gas 1

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Refinery gas	Gas 1
Biogas	Gas 2
Biogas/Natural gas	Gas 2
Blast Furnace Gas	Gas 2
CO gas	Gas 2
Coke Oven Gas	Gas 2
Coke Oven Gas/Natural gas	Gas 2
HVLC NCG	Gas 2
Hydrogen/Natural gas/ Petrochemical process gas	Gas 2
Landfill Gas	Gas 2
LVHC NCG	Gas 2
Methane	Gas 2
Methane/CO gas/CO2	Gas 2
Methane/CO2	Gas 2
Natural gas/Noncondensable Gas (includes stripper offgas)	Gas 2
Natural gas/Process coproduct gas	Gas 2
Natural gas/Process gas	Gas 2
Natural Gas/Refinery Gas/Process Gas	Gas 2
Natural Gas/Vent Gas	Gas 2
Natural gas/Pulp mill gas	Gas 2

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Noncondensable Gas	Gas 2
Noncondensable Gas (includes stripper offgas)	Gas 2
Oxygen	Gas 2
Petrochemical process gas	Gas 2
Petrochemical process gas/Natural gas	Gas 2
Petrochemical process gas/ Natural gas/Refinery gas	Gas 2
Process coproduct gas	Gas 2
Process Gas	Gas 2
Process gas/Steam	Gas 2
Pulp mill gas	Gas 2
Vent Gas for Air Pollution Control	Gas 2
Alcohol: Ethanol	Heavy Liquid
Anhydrides Waste	Heavy Liquid
Black Liquor	Heavy Liquid
Cleaning Water	Heavy Liquid
Deinking Residuals	Heavy Liquid
Hexane	Heavy Liquid
Industrial Sludge	Heavy Liquid
Industrial Sludge - Primary	Heavy Liquid
Industrial Sludge - Secondary	Heavy Liquid

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Kerosene/No. 6 Residual oil/ Noncondensable Gas/Noncondensable Gas (includes stripper offgas)	Heavy Liquid
Mixed liquid residues	Heavy Liquid
Natural gas/No. 5 Fuel oil	Heavy Liquid
Natural gas/No. 6 Residual oil	Heavy Liquid
Natural gas/Process coproduct liquid	Heavy Liquid
Natural gas/Used Petroleum-based Oils	Heavy Liquid
Natural gas/Used Petroleum-based Oils	Heavy Liquid
No. 2 Distillate/No. 6 Residual oil	Heavy Liquid
No. 5 Fuel oil	Heavy Liquid
No. 6 Residual oil	Heavy Liquid
No. 6 Residual oil/Natural gas	Heavy Liquid
No. 5 Fuel oil/No. 6 Residual oil/ Used Petroleum-based Oils (on-spec)	Heavy Liquid
Other Petroleum-based Oils	Heavy Liquid
Process coproduct liquid	Heavy Liquid
Rectified methanol	Heavy Liquid
Spent Alcohol	Heavy Liquid
Tall oil, tall oil derivatives	Heavy Liquid
Tall oil, tall oil derivatives/ No. 6 Residual oil	Heavy Liquid
Used Petroleum-based Oils	Heavy Liquid
Used Petroleum-based Oils (on-spec)	Heavy Liquid

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Used Petroleum-based Oils (on-spec) and No. 6 Residual oil	Heavy Liquid
Used Petroleum-based Oils/Natural gas	Heavy Liquid
Animal Fat/Oils/Tallow	Light Liquid
Bio liquids	Light Liquid
Diesel fuel	Light Liquid
Diesel Fuel/Animal Fat/Oils/Tallow	Light Liquid
Diesel fuel/Natural gas	Light Liquid
Jet Fuel	Light Liquid
JP-8 Aviation Fuel	Light Liquid
Kerosene	Light Liquid
Natural gas/No. 2 Distillate	Light Liquid
No. 2 Distillate	Light Liquid
No. 2 Distillate/Bio liquids/Jet Fuel	Light Liquid
No. 2 Distillate/Kerosene	Light Liquid
No. 2 Distillate/Natural gas	Light Liquid
No. 4 Fuel oil	Light Liquid
Vegetable Oil	Light Liquid
yellow grease (used cooking oil)	Light Liquid
Envirofuel pellets/cubes	Other
Fly Ash	Other

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Fuel cubes (paper diaper clippings/refuse)	Other
Glycerol Distillation Byproduct	Other
Ground Toilet Seats	Other
Heavy Recycle	Other
Hydro pulper refuse	Other
Knots and Knotter Rejects	Other
Kraft Pulp Fiber	Other
Kraft Pulp Waste Fiber	Other
Municipal Sludge	Other
Nitrile pitch residue	Other
Oily rags	Other
Paper and Paper Residues	Other
Paper Pellets	Other
Process coproduct solid	Other
Process engineered fuel	Other
Screen rejects	Other
Screen Rejects/Wax	Other
Tar	Other
Tire Derived Fuel (TDF)	Other
Wax	Other

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Construction/Demolition Derived Material	Waste
Corrugate Cardboard or Container Scraps	Waste
Plastics	Waste
Waste Derived Liquid Fuel	Waste
Wood: Treated	Waste
Biomass/Paper and Paper Residues/ Wood: Bark	Wet Biomass
Biomass/Used Petroleum-based Oils	Wet Biomass
Hog Fuel/Wood: Bark	Wet Biomass
Hog Fuel/Wood: Bark/ Wood: Unadulterated Lumber	Wet Biomass
Industrial Sludge/Tire Derived Fuel (TDF)/ Used Petroleum-based Oils (on-spec)/ Wood: Bark	Wet Biomass
Natural gas/Plant-based Agricultural Residue/Wood: Bark	Wet Biomass
No. 6 Residual oil/Wood: Bark/ Wood: Unadulterated Timber	Wet Biomass
Paper Pellets/Wood: Bark	Wet Biomass
Reinjection char/Wood: Bark/ Wood: Unadulterated Lumber/ Wood: Unadulterated Timber	Wet Biomass
Wood: Bark	Wet Biomass
Wood: Bark/Hog Fuel	Wet Biomass
Wood: Bark/Hog Fuel/Wood: Plywood, Particleboard (containing glues or resins)	Wet Biomass
Wood: Bark/Industrial Sludge	Wet Biomass
Wood: Bark/Wood: Plywood, Particleboard (containing glues or resins)	Wet Biomass
Wood: Bark/Wood: Unadulatered	Wet Biomass

Appendix B-1: Mapping Reported Fuels Combusted to Fuel Categories

Reported Fuel	Fuel Category
Wood: Bark/Wood: Unadulatered/ Wood: Adulterated	Wet Biomass
Wood: Bark/Wood: Unadulterated Lumber	Wet Biomass
Wood: Bark/Wood: Unadulterated Lumber/ Wood: Unadulterated Timber	Wet Biomass
Wood: Bark/Wood: Unadulterated Timber	Wet Biomass
Wood: Bark/Wood: Unadulterated Timber/ Wood: Unadulterated Lumber/ Other Petroleum-based Oils	Wet Biomass
Wood: Unadulterated Lumber/ Wood: Unadulterated Timber/ Wood: Bark/Reinjection Char	Wet Biomass
Wood: Unadulterated Timber	Wet Biomass
Wood: Unadulterated Timber/ Wood: Treated	Wet Biomass
Wood: Unadulterated Timber from Land Clearing Operations	Wet Biomass

Notes:

1. The fuels listed here are fuels reported to be combusted at major source boilers and process heaters. If the material is classified as a waste material, the material was either reported to be no longer used in the boiler or process heater, or used in small quantities such that EPA assumed the unit would cease to combust the material if the material was concluded to be a waste material.
2. Emissions data reported while burning materials classified as waste are not used in the MACT floor analysis.
3. Consistent with the definition of coal in the vacated boiler MACT rule, petroleum coke is classified in the coal fuel category in this emission test database.

Appendix C-1: Combustor Design Categories

Reported Combustor Design	Coal	Biomass	Liquid	Gas 1	Gas 2
Cyclone	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Cyclone/ Dutch Oven	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Cyclone/ Fuel Cell/ Gasifier/ Other	Stoker/Sloped Grate/Other	Fuel Cell	N/A	N/A	N/A
Cyclone/ Fuel Cell/ Other	Stoker/Sloped Grate/Other	Fuel Cell	N/A	N/A	N/A
Cyclone/ Suspension Burner	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Dutch Oven	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Dutch Oven/ Gasifier	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Fluidized Bed (FB)	FB	FB	N/A	N/A	N/A
FB/ Cyclone	FB	FB	N/A	N/A	N/A
FB/Sloped Grate	FB	FB	N/A	N/A	N/A
FB/ Suspension Burner	FB	FB	N/A	N/A	N/A
Fuel Cell	Stoker/Sloped Grate/Other	Fuel Cell	N/A	N/A	N/A
Fuel Cell/ Gasifier	Stoker/Sloped Grate/Other	Fuel Cell	N/A	N/A	N/A
Fuel Cell/ Other	Stoker/Sloped Grate/Other	Fuel Cell	N/A	N/A	N/A
Gasifier	Gasifier	Gasifier	N/A	N/A	N/A
Pulverized Coal (PC)	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
PC/Cyclone	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A

Appendix C-1: Combustor Design Categories

Reported Combustor Design	Coal	Biomass	Liquid	Gas 1	Gas 2
PC/Other	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
PC/ Suspension Burner	PC	Dutch Oven/Susp. Burner	N/A	N/A	N/A
PC/ Suspension Burner/ Other	PC	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Sloped Grate	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Other	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Sloped Grate	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Sloped Grate/ Suspension Burner/ Dutch Oven/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Suspension Burner/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Suspension Burner/ Other	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Cyclone/ Suspension Burner/ Sloped Grate/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A

Appendix C-1: Combustor Design Categories

Reported Combustor Design	Coal	Biomass	Liquid	Gas 1	Gas 2
Stoker/ Dutch Oven	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/FB	FB	FB	N/A	N/A	N/A
Stoker/FB/ Cyclone/ Sloped Grate	FB	FB	N/A	N/A	N/A
Stoker/ Fuel Cell	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Fuel Cell/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Other	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Other/ Suspension Burner	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/PC	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/PC/Other	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/PC/ Sloped Grate	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/PC/ Suspension Burner	PC	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Sloped Grate	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Sloped Grate/ Gasifier	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Suspension Burner	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Suspension Burner/ Other	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Stoker/ Suspension Burner/ Sloped Grate	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A

Appendix C-1: Combustor Design Categories

Reported Combustor Design	Coal	Biomass	Liquid	Gas 1	Gas 2
Suspension Burner	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Suspension Burner/ Other	Stoker/Sloped Grate/Other	Dutch Oven/Susp. Burner	N/A	N/A	N/A
Suspension Burner/ Sloped Grate	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Not Specified	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A
Other	Stoker/Sloped Grate/Other	Stoker/Sloped Grate/Other	N/A	N/A	N/A

Notes:

1. Units firing gas and liquid fuels were not subcategorized according to combustor design.
2. Units that selected more than one combustor design were assigned to a combustor category using the hierarchy shown in this table.