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Topical Report

Measurement of Air Toxic Emissions from Natural Gas-Fired Internal Combustion Engines at Natural Gas Transmission and Storage Facilities

Volume II: Appendices

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16. Abstract (limit: 200 words)

This report presents the results of a preliminary field study to evaluate air emissions from natural gas-fired internal combustion engines and turbines. The primary focus of the study was to quantify and speciate emissions of hazardous air pollutants (HAPs). Emissions data were collected at six natural gas transmission and storage facilities in four campaigns. Through this effort, 16 different natural gas-fired reciprocating engines and 1 natural gas-fired turbine were tested. A higher priority was placed on collecting data from reciprocating engines than turbines based on preliminary data from an earlier phase of the program that indicated that air toxic concentrations in natural gas-fired turbine exhaust were very low (and much lower than that of engines).

Of the 47 volatile and semi-volatile compounds examined during the study, formaldehyde was the only HAP present in engine exhausts at sufficient levels to potentially exceed the EPA's 10 ton/yr major source threshold in some cases. Emission rates ranged from <0.1 to 0.5 g/hp-hr, and appear to depend on both engine design and operating characteristics.

Exhaust concentrations of air toxic compounds were lower for the natural gas-fired turbine than engines. Acetaldehyde was the HAP measured at the highest concentration in turbines, with measured formaldehyde levels lower. The acetaldehyde emission factors for this turbine was 0.020 g/hp-hr; formaldehyde emissions were non-detectable (0.2 ppmv). The mechanism that favors acetaldehyde formation over formaldehyde has not yet been identified.

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Appendix A

Sample Calculations

Sample Calculations

Load

$$\frac{\text{Operating hp}}{\text{Rated hp}} \times \frac{\text{Rated rpm}}{\text{Operating rpm}} \times 100(\%) = \text{Load } (\%)$$

Heat Input

$$\text{Fuel Flow} \left[\frac{\text{scf}}{\text{min}}\right] \times \text{Heating Value of Fuel} \left[\frac{\text{Btu}}{\text{scf}}\right] \times \left[\frac{60 \text{ min}}{\text{hr}}\right] \times \left[\frac{\text{MMBtu}}{10^6 \text{ Btu}}\right]$$

$$= \text{Heat Input} \left[\frac{\text{MMBtu}}{\text{hr}}\right] \quad \text{Can be based on HHV or LHV}$$

Heat Rate

$$\text{Heat Input [Based on LHV]} \left[\frac{\text{MMBtu}}{\text{hr}}\right] \times \frac{1}{\text{Operating hp}} \times \left[\frac{10^6 \text{ Btu}}{\text{MMBtu}}\right]$$

$$= \text{Heat Rate} \left[\frac{\text{Btu}}{\text{hp-hr}}\right] \quad \text{Based on LHV}$$

Fd Factor Calculation

$$\frac{1.53\left[\frac{scf}{lb}\right](\%wt.\ C)+3.64\left[\frac{scf}{lb}\right](\%wt.\ H)+0.14\left[\frac{scf}{lb}\right](\%wt.\ N)-0.46\left[\frac{scf}{lb}\right](\%wt.\ O)}{HHV\left[\frac{Btu}{scf}\right]\times 385.5\left[\frac{scf}{lb\text{-}mole}\right]\times\frac{1}{MW_{fuel}}\left[\frac{lb\text{-}mole}{lb}\right]\times\left[\frac{MMBtu}{10^6\ Btu}\right]}$$

$$= Fd\left[\frac{dscf\ @\ 0\%\ O_2}{MMBtu}\right]$$

Example Calculation of Fd Factor

Gas Analysis HHV = 1159 Btu/scf $MW_{fuel} = 19.01\ \frac{lb}{lb\text{-}mole}$

	Mole %	x MW	= Weight per 100 moles	Weight %
N_2	0.792	28	0.2218	1.169
CO_2	0.078	44	0.0343	0.1809
CH_4	80.954	16	12.95	68.30
C_2H_6	16.423	30	4.927	25.99
C_3H_8	1.479	44	0.6508	3.432
i-C_4H_{10}	0.04	58	0.0232	0.1223
n-C_4H_{10}	0.133	58	0.0771	0.4066
i-C_5H_{12}	0.035	72	0.0252	0.1329
n-C_5H_{12}	0.048	72	0.0346	0.1825
C_{6+} as C_6H_{14} =	0.018	86	0.0155	0.0818
	100.0		18.96	99.99

$N = \underline{1.169\%\ wt}$

$$C = \frac{12}{44}(0.1809) + \frac{12}{16}(68.3) + \frac{24}{30}(25.99) + \frac{36}{44}(3.432) +$$

$$\frac{48}{58}(0.1223) + \frac{48}{58}(0.4066) + \frac{60}{72}(0.1329) + \frac{60}{72}(0.1825)$$

$$+ \frac{72}{86}(0.0818) = \underline{75.64\%}$$

$$H = \frac{4}{16}(68.3) + \frac{6}{30}(25.99) + \frac{8}{44}(3.432) + \frac{10}{58}(0.1223)$$

$$+ \frac{10}{58}(0.4066) + \frac{12}{72}(0.1329) + \frac{12}{72}(0.1825)\ \frac{14}{86}(0.0818) = \underline{23.05\%}$$

$$O = \frac{32}{44}(0.1809) = \underline{0.1316\%}$$

$$Fd = \frac{1.53\ (75.64) + 3.64\ (23.05) + 0.14\ (1.169) - 0.46\ (0.1316)}{\left[1159\ \frac{Btu}{scf}\right]\left[\frac{385.5\ scf}{lb\text{-}mole}\right]\left[\frac{MMBtu}{10^6\ Btu}\right]\left[\frac{lb\text{-}mole}{19.01\ lb}\right]}$$

$$= \underline{8498\ \frac{dscf}{MMBtu}}$$

Method 19 Flow Rate Calculation

$$F_d \left[\frac{\text{dscf @ 0\% } O_2}{\text{MMBtu}}\right] \text{ x Heat Input } \left[\frac{\text{MMBtu}}{\text{hr}}\right] \text{ x } \left[\frac{\text{1 hr}}{\text{60 min}}\right] \text{ x } \left[\frac{20.9}{20.9 - O_2 \%}\right]$$

$$= \text{Stack Flow Rate } \left[\frac{\text{dscf}}{\text{min}}\right]$$

where $O_2\%$ is exhaust concentration of O_2 based on CEM results.

Convert ppmvw to ppmvd

$$\text{ppmvw x } \frac{1}{1 - \dfrac{\% \; H_2O \text{ in exhaust}}{100}} = \text{ppmvd}$$

Convert ppmvd to ppmvd at 15% O_2

$$\text{ppmvd x } \frac{20.9 - 15}{20.9 - O_2\%} = \text{ppmvd @ 15\% } O_2$$

where $O_2\%$ is dry exhaust concentration of O_2 based on CEM results.

Convert ppmvd to lb/hr

$$\text{ppmvd x } \left[\frac{\text{1 million}}{10^6}\right] \text{ x exhaust flow } \left[\frac{\text{dscf}}{\text{min}}\right] \text{ x } \left[\frac{\text{60 min}}{\text{hr}}\right] \text{ x } \left[\frac{\text{lb-mole}}{\text{385.5 scf}}\right] \text{ x}$$

$$MW_{\text{pollutant}} \left[\frac{\text{lb}}{\text{lb-mole}}\right] = \text{emission rate } \left[\frac{\text{lb}}{\text{hr}}\right]$$

Convert lb/hr to g/Hp-hr

$$\left[\frac{lb}{hr}\right] \times \left[\frac{453.6\ g}{lb}\right] \times \frac{1}{\text{operating hp}} = \frac{g}{hp\text{-}hr}$$

Convert lb/hr to lb/MMBtu

$$\left[\frac{lb}{hr}\right] \times \left[\frac{hr}{MMBtu}\right] = \frac{lb}{MMBtu}$$

Convert lb/hr to tons/yr

$$\left[\frac{lb}{hr}\right] \times \left[\frac{ton}{2000\ lb}\right] \times \left[\frac{8760\ hr}{yr}\right] = \frac{tons}{yr}$$

Convert μg/dscf to lb/hr

$$\left[\frac{\mu g}{dscf}\right] \times \left[\frac{g}{10^6\ \mu g}\right] \times \left[\frac{lb}{453.6\ g}\right] \times \text{exhaust flow} \left[\frac{dscf}{min}\right] \times \left[\frac{60\ min}{hr}\right]$$

$$= \text{emission rate} \left[\frac{lb}{hr}\right]$$

Fuel Flow Calculations From Orifice Meter

$$C_o \times \left[\sqrt{\frac{2 \times g_c \times \Delta P}{\rho \times (1-\beta^4)}}\right] \times \pi \times r^2 \times \left[\frac{3600 \text{ sec}}{\text{hr}}\right] = \text{Flow rate} \left[\frac{\text{acf}}{\text{hr}}\right]$$

$$\text{Flow rate (scfm)} = \frac{\text{acf}}{\text{hr}} \times \left[\frac{\text{hr}}{60 \text{ min}}\right] \times \left[\frac{P}{14.7}\right] \times \left[\frac{460 + 68}{460 + T}\right]$$

where

C_o = Orifice Coefficient

$g_c = 32.2 \left[\frac{\text{ft-lb}}{\text{lb}_f - \text{s}^2}\right]$

ΔP = Pressure Drop Across Orifice (psia)

$$\rho = \text{gas density} \left[\frac{\text{lb}}{\text{ft}^3}\right] = \frac{MW_g \left[\frac{\text{lb}}{\text{lb-mole}}\right] \times P \text{ (psia)}}{R \left[\frac{\text{psia} \cdot \text{ft}^3}{\text{lb-mole} \cdot {}^\circ\text{R}}\right] \times T\ ({}^\circ\text{K})}$$

P = Gas Pressure (psia)

T = Gas Temperature (°R)

$R = \text{Ideal Gas Constant} = 10.73 \left[\frac{\text{psia} \cdot \text{ft}^3}{\text{lb-mole} \cdot {}^\circ\text{R}}\right]$

ß = Ratio of Orifice Diameter to Pipe Diameter

r = Orifice Diameter

Appendix B

Detailed Description of Analytical Methods

B.0 SAMPLING AND ANALYTICAL METHODS

Sample collection, analysis, and continuous emissions monitoring methods used to collect field measurement data are described in this section. Manual measurements were performed using established reference methods whenever possible. The referenced methods were modified, as necessary, for application to the sample matrix and target compound concentrations. Continuous emissions monitoring was also conducted using referenced methods, with the exception of FTIR. The FTIR measurements were conducted according to an operational protocol developed specifically for the GRI Air Toxics Program.

B.1 Manual Methods

Manual sampling and analytical methods were used to monitor the following parameters:

- Exhaust flow rate;
- Exhaust molecular weight;
- Exhaust moisture content;
- Aldehydes;
- Volatile organic compounds;
- Semivolatile organic compounds;
- Metals; and
- PM_{10}.

The sampling and analytical methods used to monitor each of these parameters are described below.

B.1.1 EPA Method 1 - Sampling Traverse Point Selection

The procedures specified in EPA Method 1 were used to determine the number and location of sampling traverse points required for performing a velocity profile and to obtain a representative gas sample. EPA Method 1 parameters are based upon the length of duct separating the sampling ports from the closest downstream and upstream flow disturbances. The minimum number of total traverse points for a circular duct less than 24 inches is 8 (4 per diagonal). Traverse point locations are determined for each sample port depending on its distance from duct disturbances.

B.1.2 EPA Method 2 - Gas Flow Rate

The procedures specified in EPA Method 2 were used to measure the flow rate of gas in exhaust streams. Based on this method, a Type K thermocouple and Type S pitot tube were used to measure the temperature and velocity of the exhaust gas, respectively. During testing, the thermocouple and pitot tube were housed in a either a 3/8-inch diameter or a 1-inch diameter stainless steel sheathed probe. The sheathed probe allowed the use of a packing gland in those gas streams where toxic and/or hot gases were present. In small diameter process lines and exhaust stacks, individual small velocity probes were used to minimize the effect the probe might have as a flow obstruction.

B.1.3 EPA Method 3A - Gas Molecular Weight

The molecular weight of the exhaust gas was determined based on analysis of the main components in the gas stream. The concentration of O_2 and CO_2 present in the combustion exhaust gas streams was determined according to the procedures specified in EPA Method 3A, where the gas streams are monitored using continuous analyzers. The remainder of the gas composition was assumed to be water and nitrogen, for the purposes of molecular weight calculation. Moisture content of the gas stream was determined by EPA Method 4 or by FTIR.

B.1.4 EPA Method 4 - Gas Moisture Content

The moisture content of the exhaust gases was determined using the procedures specified in EPA Method 4. In this method, the moisture associated with a known volume of gas was removed from the gas stream via condensation in a series of chilled impingers and absorption in silica gel. The mass of water collected was measured and related back to the known dry gas volume to determine the moisture content of the gas stream. Figure B-1 presents the sample collection train configuration for this method.

B.1.5 EPA Method 18 - Total Volatile Organic Compounds (T-VOCs)

The concentration of T-VOCs present in the engine combustion exhaust gases was determined on site using the procedures specified in EPA Method 18. Based on this method, the concentration of C_1-C_7 organic compounds that have a boiling point less than 100°C were determined using a GC with an FID. The detection limit for this method is approximately 0.5 ppm. The specific GC model utilized in the test program was a Hewlett-Packard Model 5890.

A multipoint calibration was performed daily using C_1-C_7 n-alkane standard gas mixtures. A retention time versus boiling point calibration curve was prepared for each compound in the standard gas mixture.

A stainless steel sample line was used to transport unconditioned sample gas from the heated CEM sample line to the heated valve on the GC. The stainless steel line was heat traced and maintained above 100°C to prevent loss of analytes due to condensation, according to EPA Method 18 procedures. The sample gas was passed continuously through a heated six-port sampling valve, which injected samples into the GC on a

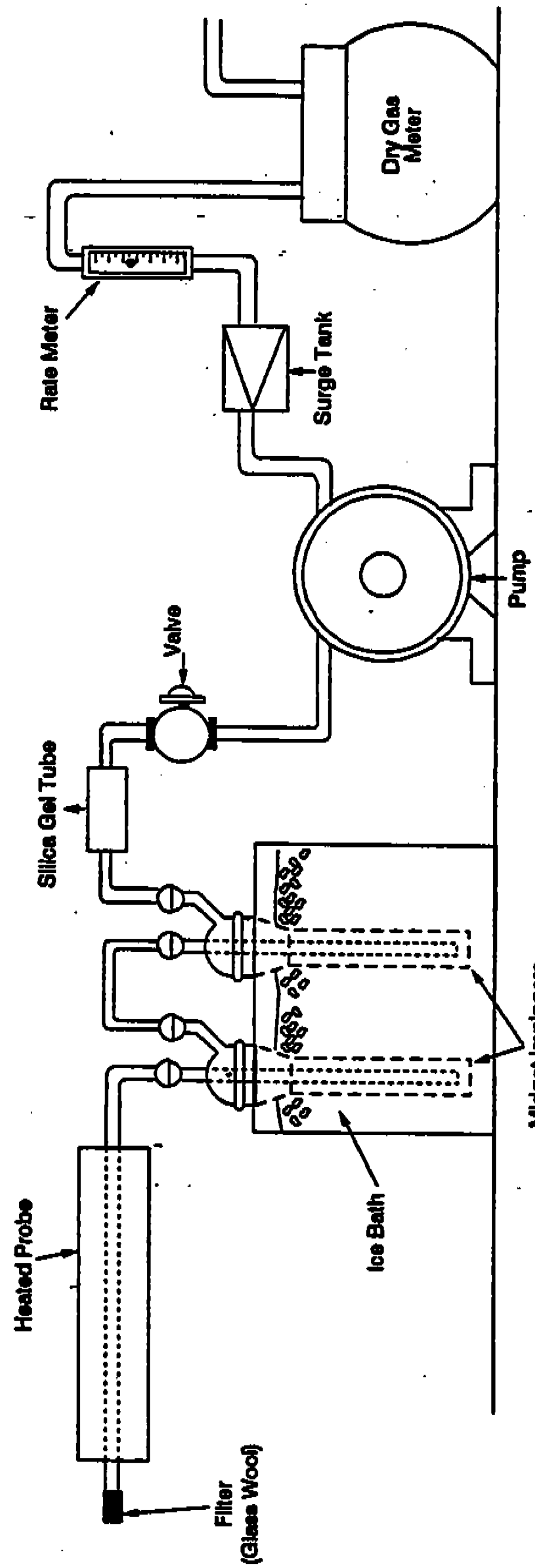

Figure B-1. Configuration of EPA Method 4 Sample Collection Train sequential basis during each test period. Sampling frequency was determined by the total cycle time for sample analysis, which includes the retention time for the sample in the GC column and the time for the GC oven temperature to return to the initial value. Typical cycle time was 15-20 minutes.

B.1.6 SW-846 Method 0030 - Volatile Organic Compounds

Samples of exhaust gases were collected using the VOST technique, as specified in SW-846 Method 0030. This method utilized Tenax and Tenax/Charcoal traps for adsorbing volatile organic compounds (bp <100°C) from the exhaust stream. Figure B-2 presents the sample collection train configuration for this method.

The exhaust gases were screened by FTIR to establish approximate levels of volatile organics prior to VOST sampling. Sample gas volumes from 1 to 20 liters were used to ensure that target compound breakthrough did not occur. Each sample was collected at a rate of 1 liter per minute. The VOST tubes were kept cool prior to, during, and after sample collection. Analysis of the VOST sample sets was performed using the gas chromatography/mass spectroscopy procedures specified in SW-846 Method 8240.

The VOST method was modified slightly to collect three pairs of tubes and a field blank per condition. Two sets of tubes were analyzed and the third held in reserve should the results of the first two analyses not agree or if the levels of the target analytes were inappropriate for the analytical instrumentation and adjustments were needed before the analysis of the remaining samples. Data from this technique were compared to that collected using canisters and the FTIR protocol.

A volatile organic target analyte, 1,3-butadiene, has been reported to be unstable on solid sorbent materials such as Tenax and charcoal. The concentration of this compound was measured using FTIR and canister techniques, if it was present at levels above 50 ppbv.

B.1.7 EPA Method TO-14 - Volatile Organic Compounds

A modified version of EPA Method TO-14 was used to collect and analyze canister samples of exhaust gases. This method was originally developed for the collection of ambient air samples. Sample collection was accomplished using evacuated SUMMA® polished stainless steel canisters. Mechanical flow controllers were used to collect time-integrated samples over a one- to two-hour period.

The canisters containing the samples were transported to the laboratory where a portion of the sample was removed and cryogenically concentrated (if necessary) prior to analysis using a gas chromatograph with multiple detectors (GC/MD). In this effort, the primary quantitation detector was the flame ionization detector (FID). The canister collection technique was applicable for volatile organic compounds in the methane through C_{10} boiling range.

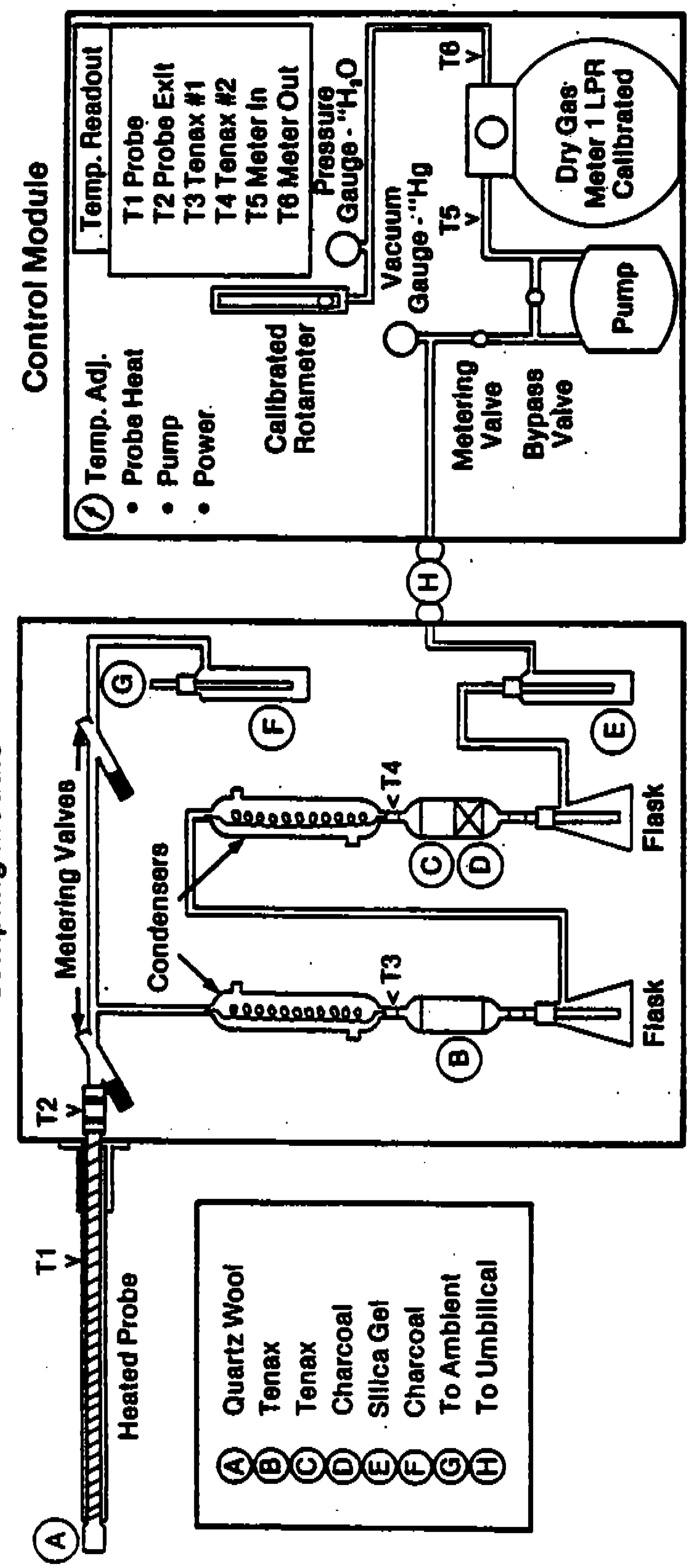

Figure B-2. SW-846 Method 0030 Volatile Organic Sampling Train

B.1.8 SW-846 Method 0010 - Semivolatile Organic Compounds

SW-846 Method 0010, Modified Method 5 sampling train, was used for semivolatile organic compound analysis. In this method, gaseous and particulate pollutants were withdrawn from the source under isokinetic conditions and collected using a multicomponent sampling train. Particulates were collected on a quartz fiber filter. Semivolatile organic compounds were collected in a sorbent trap packed with XAD-2 resin. An impinger train follows the XAD-2 resin cartridge and was used to remove the moisture present in the sample gas prior to entering the pump and dry gas meter. Figure B-3 presents the sample collection train configuration for this method.

The filter and XAD resin were extracted, concentrated, and analyzed for the targeted semivolatile organic compounds along with all the other target compounds for SW-846 Method 8270. All analyses were performed by GC/MS. In addition to the semivolatile organic compounds, the largest 10 peaks in the chromatogram were identified.

B.1.9 CARB Method 429 - Semivolatile Organics Compounds

CARB Method 429 was used to collect samples from the engine exhaust gases for semivolatile organics compound analysis. In this method, gaseous and particulate pollutants were withdrawn from the source under isokinetic conditions and collected using a multicomponent sampling train. Particulates were collected on a Teflon-coated glass or Teflon membrane filter. Semivolatile organic compounds were collected in a sorbent trap packed with XAD-2 resin. An impinger train follows the XAD-2 trap and was used to remove the moisture present in the sample collected at the engine exhaust location. Each sample train was collected by traversing both diagonals of the duct or stack. Only one sample train, instead of triplicate samples, was collected per engine.

The filter and XAD-2 resin were extracted, concentrated, and analyzed for the targeted semivolatile organic compounds using low resolution mass spectrometry (LRMS).

B.1.10 CARB Method 430 - Aldehydes

CARB Method 430 was used to measure the concentration of aldehydes present in exhaust gases. Based on this method, a sample (i.e., gaseous and particulate) was withdrawn from the source of interest and collected in a series of chilled impingers containing aqueous acidic 2,4-dinitrophenylhydrazine (DNPH). Carbonyl compounds present in the sample reacted with the DNPH to form dinitrophenylhydrazone derivatives. The dinitrophenylhydrazone derivatives were extracted, solvent-exchanged, concentrated, and then analyzed by high performance liquid chromatography (HPLC) with ultraviolet detection. Figure B-4 presents the sample collection train configuration for this method.

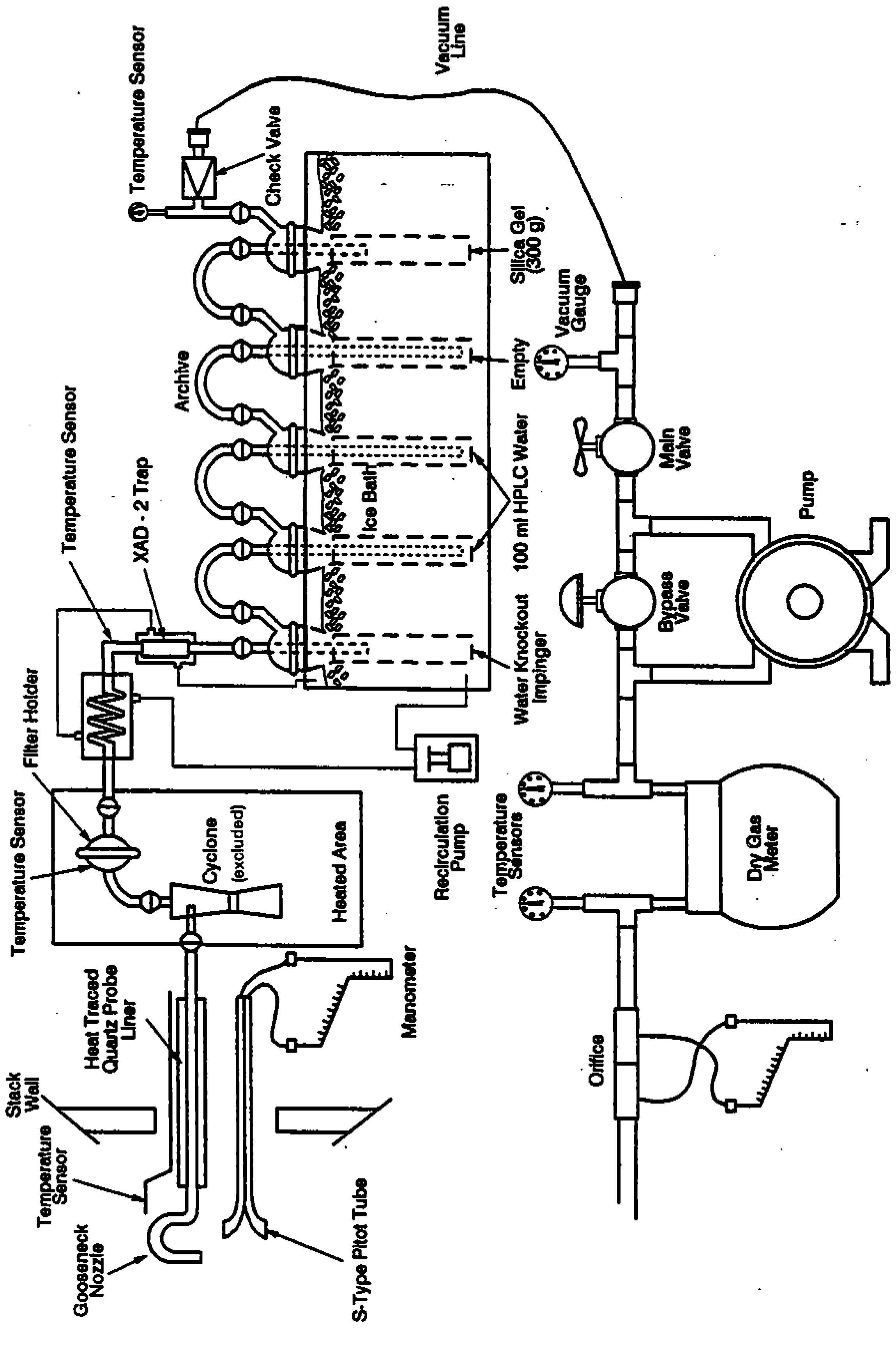

Figure B-3. SW-846 Method 0010 Modified Method 5 Sampling Train

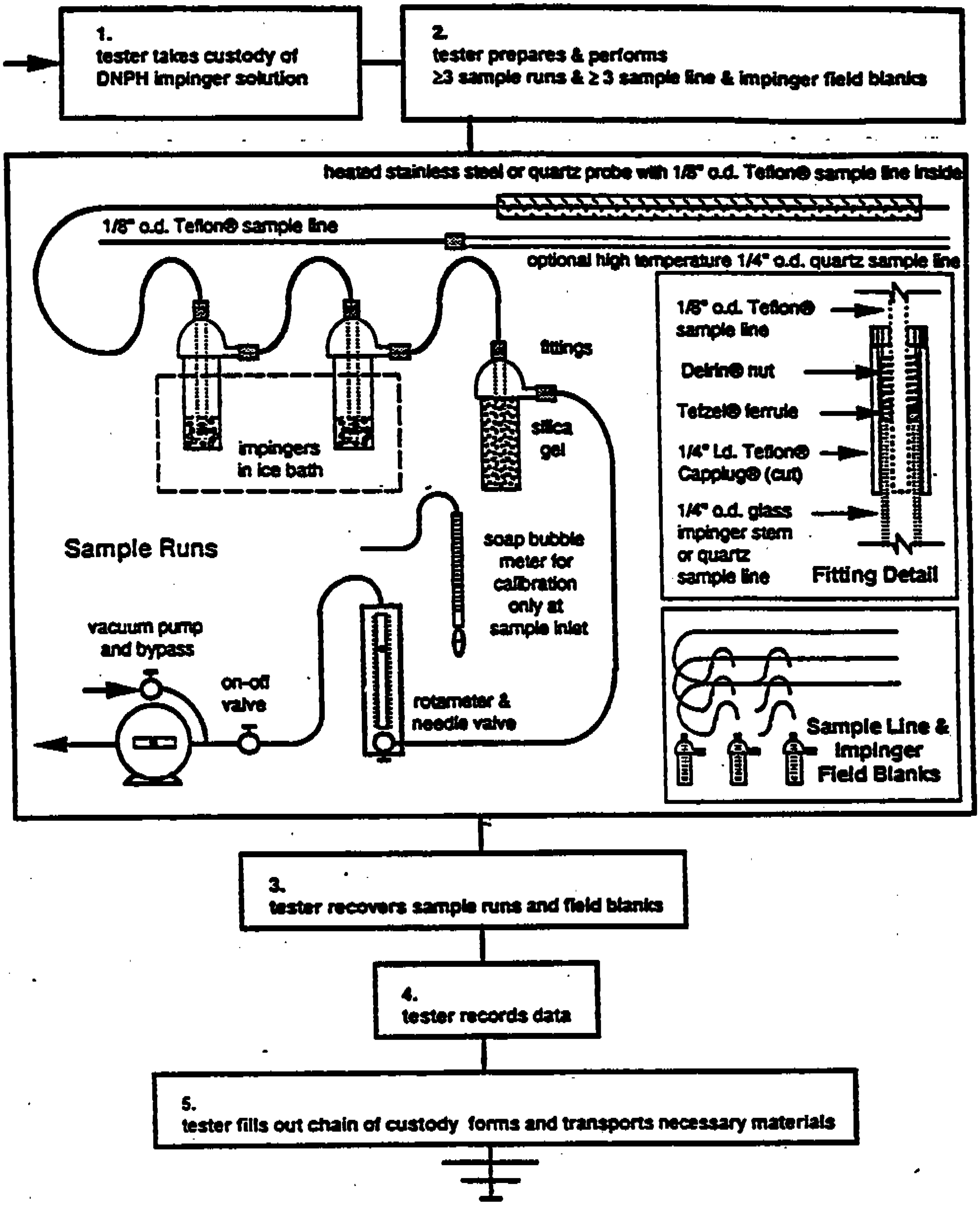

Figure B-4. Configuration of CARB Method 430 (Carbonyl) Sample Collection Train

This method was chosen due to the number of replicates collected (3 per site or condition) and the level of quality control required by the method which insures valid data collection. All quality control procedures, including a field blank for each replicate and a field spike sample were followed, as well as the recommended hold times for the DNPH solution and samples after collection.

Sample volumes for CARB Method 430 were adjusted on site to avoid depletion of the DNPH solution during sampling. Due to the potentially high levels of formaldehyde and other aldehydes in the exhaust stacks, the exhaust gas was screened by FTIR to establish approximate concentrations, and sample volumes were adjusted to insure an excess of DNPH during the sampling period.

Three DNPH absorbing impingers were used. Analysis of the third impinger provided information pertaining to the collection efficiency of the train for each of the aldehydes of interest. To rinse the impinger and maximize recovery of the hydrazone which can precipitate and cling to the glassware, 10 ml of extraction solution was used.

B.1.11 SW-846 Method 0012--Metals

Method 0012 entitled, "Methodology for the Determination of Metal Emissions in Exhaust Gases from Hazardous Waste Incineration and Other Similar Combustion", was developed to allow for the determination of metals emissions in stationary source exhaust gases. Based on this method, sample (i.e., gaseous and particulate) was withdrawn isokinetically from the source of interest. Particulate emissions were collected in the probe and on a heated quartz filter. Gaseous emissions were collected in a series of chilled impingers containing absorbing solutions. The first two absorbing impingers contained a nitric acid/hydrogen peroxide solution. The third and fourth absorbing impingers contained a potassium permanganate/sulfuric acid solution.

Materials collected in the sampling train were digested in acid solutions to dissolve inorganic compounds and to remove organic constituents that may have created analytical interferences. Acid digestion was performed using conventional Parr Bomb or microwave digestion techniques. The nitric acid and hydrogen peroxide impinger solution, the potassium permanganate impinger solution, the hydrochloric acid solution (used to rinse the sampling train components during sample recovery), and the digested filter solutions were analyzed for mercury by CVAAS and analyzed for arsenic by GFAAS. These samples were also screened for the presence of other metals using ICAP.

B.1.12 EPA Method 201A--PM_{10}

The procedure specified in EPA Method 201A was used to determine the concentration of PM_{10} present in the combustion exhaust stacks during a limited number of tests. An Anderson Mark 4 precutter was used to provide a Dp_{50} of 10 microns in the stack. Calibration data provided by Anderson were used to set the operating conditions of the sampling train to achieve the 10 micron cut-point. A constant flow rate of gas was maintained throughout the entire test period, as specified in Method 201A.

An in stack, preweighed 47 mm quartz filter was used to collect any solids exiting the precutter. A heated glass-lined probe maintained at 250°F was used to transport the flue gas exiting the filter holder to the impinger train. Velocity profile data obtained during flue gas flow rate measurements were used to determine the isokinetic sampling conditions.

After sampling, the exit of the precutter and the front side of the filter holder were rinsed with acetone and water to recover any solids present. The filter was removed, placed in a sample petri dish, and sealed for transport to the laboratory. The filter holder rinse samples were placed in preweighed beakers and then evaporated to dryness. The beakers were desiccated along with the filter samples and weighed to determine the mass of solids present. This information was used along with the sample gas volume to calculate the total mass loading and the mass loading associated with the filter holder rinse and filter.

B.1.13 EPA Method 202-Condensible Particulate Matter

The procedures specified in EPA Method 202 were used to determine the mass of condensible particulate matter present in the engine exhaust stream during some runs. Following this method, flue gas exiting the filter used during PM_{10} sampling was passed through three imprinters where any condensible material was collected in deionized water. At the end of testing, the contents of the three impingers were combined into one sample for analysis. The analysis consisted of evaporating the samples in a preweighed beaker, drying the beakers with desiccant, and reweighing the beakers to determine the mass gain. The mass gain was then used along with the measured sample gas volume to determine the concentration of condensible matter in the exhaust gas streams.

B.1.14 Fuel Gas Composition and Heating Value

Natural gas samples for composition analysis and heating value calculations were collected in evacuated stainless steel containers during GRI Campaigns 4, and 6; and at Compressor Station 3A of Campaign 3. Mechanical flow controllers were used to fill the containers at line pressure over a five-minute period. The sample containers were analyzed by the host company for composition and heating value using Gas Processors Association (GPA) Method 2261.

B.2 Continuous Emissions Monitoring

FTIR was used to measure the concentration of target air toxic compounds on a continuous basis. In addition, O_2, CO_2, THC, NO_x and CO were measured on a continuous basis.

A continuous emissions monitoring (CEM) system was used in the field measurement program as shown in Figure B-5 (excluding GC). The configuration of the CEM system was comprised of four sub-systems:

- Sample gas extraction and transfer equipment;
- Conditioned sample gas analysis instrumentation;
- Unconditioned sample gas analysis instrumentation; and
- Calibration and QA standards delivery equipment.

Each of these subsystems is described below.

B.2.1 Sample Gas Extraction and Transfer System

Sample gas extraction and transfer equipment were used to remove and distribute a continuous representative flow of sample gas from the source effluent stream to the analyzers. A heated head pump was used to pull sample gas through a sintered steel filter/probe assembly or a rake probe assembly into one tube of a multi-tube, heat-traced sample line. The sample gas was then delivered to an insulated sample manifold for further distribution, with the total sample extraction flow rate controlled by a flow control valve located at the exit of the heated head pump. A rotameter was located in-line at the exit of the sample manifold to set the overall sample extraction flow rate prior to monitoring and as a visual indicator to insure that an adequate volume of sample gas (i.e., a flow rate in excess of the total sample uptake rate of all the analysis instrumentation) was maintained.

To reduce the potential for bias associated with condensation and line losses, a high sample gas extraction flow rate (i.e., approximately 12-18 L/min) was used, and all surfaces contacting the sample gas were maintained at approximately 300°F.

B.2.2 Conditioned Sample Gas Analysis Instrumentation

The sample gas conditioning equipment was used to remove particulates, moisture, and other condensibles from the sample gas stream via a series of glass condensers/chillers. Measurements of O_2, CO_2, NO_x, and CO were made on a dry basis from the conditioned sample gas stream. Sample gas was extracted from the insulated sample gas distribution manifold, conditioned, and delivered to the O_2, CO_2, NO_x, SO_2, and CO analyzers. Because each of these instruments incorporate destructive detectors, each used separate, internally located pumps to pull sample gas from the conditioned stream at a controlled flow rate (approximately 1 L/min. each).

Measurement of O_2 and CO_2 concentration in the sample gas was conducted according to EPA Method 3A. A Servomex Model 1400 analyzer with a range of 0 to 25 percent O_2 was used for O_2 measurements. The Servomex analyzer uses a paramagnetic cell to produce a linearized voltage signal proportional to the ratio of the oxygen concentration of a reference gas to the oxygen concentration of the sample. An Ametek Model WDG-III O_2 analyzer was used during part of Campaign 2. The Ametek

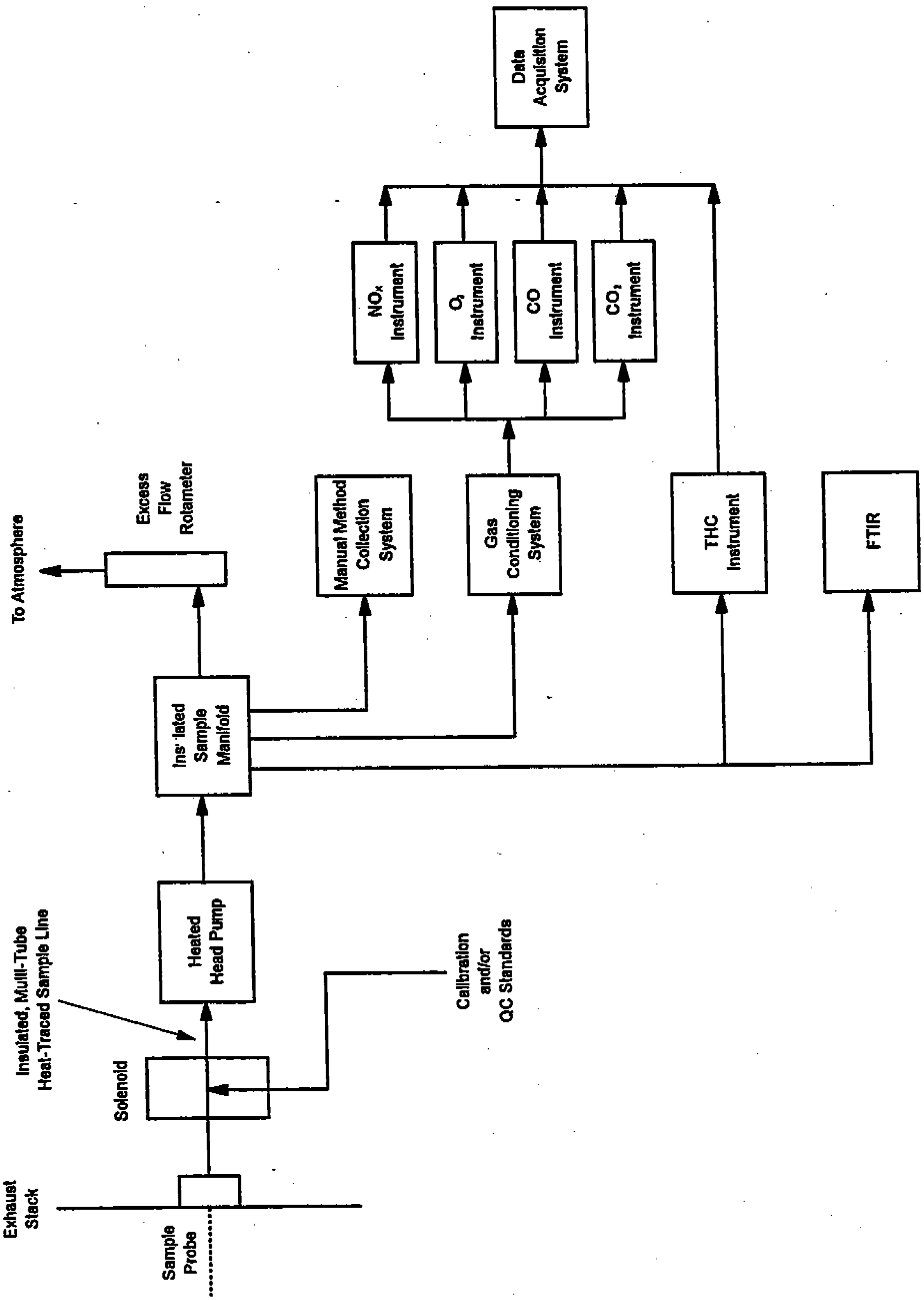

Figure B-5. Configuration of the Overall CEMs

O_2 analyzer uses an electrochemical cell to produce a linearized voltage signal proportional to the ratio of oxygen concentrations of the sample and a reference gas. The instrument range was 0 to 25 percent O_2.

Three different analyzers were used for measurement of CO_2 concentration during this project. A Beckman Model 865-23 analyzer was used during Campaign 1. A Horiba CO_2 analyzer was used during Campaigns 3 and 4. A Servomex Model 1400 analyzer was used during Campaign 6. All three analyzers use a nondispersive infrared test cell to determine CO_2 concentrations based on the infrared light absorption at the test gas sample. The analyzer range for each instrument was 0 to 20 percent CO_2.

Measurement of NO_x was conducted according to EPA Method 7E. A TECO Model 10AR was used during all test campaigns to measure total concentrations of NO_x in the gas streams. The instrument operates on the chemiluminescence principle, and was calibrated over a range suitable for the concentration of NO_x at the particular source being tested. The TECO analyzer used converts all nitrogen oxides in the sample to nitric oxide (NO), and then reacts the NO with ozone in a photomultiplier tube, providing a signal proportional to the NO_x concentration in the sample.

Measurement of CO was conducted according to EPA Method 10. A TECO Model 48H analyzer was used during all test campaigns to measure CO in the combustion gas stream. The instrument was calibrated over a range suitable for the concentration of CO at the particular source being tested. The TECO 48H analyzer uses a non-dispersive infrared test cell to determine CO concentration based on the infrared light absorption of the test gas sample. The instrument uses a gas filter correlation technique to eliminate interferences from other gaseous compounds present in the sample gas.

B.2.3 Unconditional Sample Gas Analysis Instrumentation

Measurement of target air toxic compounds and THC were made on a wet basis from an unconditioned sample gas stream. Unconditioned gas was used to avoid losses of target analytes during the conditioning. Sample gas was removed from the insulated sample gas distribution manifold without conditioning and delivered directly to the FTIR and THC instrumentation through temperature controlled transfer lines. Canister samples were also removed from the heated, unconditioned gas stream. Separate samples were collected by each instrument due to differences in flow rate required for analysis. The FTIR utilized a heated head sample pump located external to the instrument to pull sample gas, at a controlled flow rate (approximately 1 L/min), through the FTIR instrument. The THC instrument used a similar arrangement to deliver unconditioned gas to the FID for measurement of total hydrocarbons.

Measurement of THC was conducted according to EPA Method 25A. A Ratfisch Model RS-55 analyzer was used during all test campaigns except for Campaign 6. A J.U.M. Model VE7 THC analyzer was used for THC analysis during Campaign 6. The instruments were calibrated over a range suitable for the concentration of THC at the particular source being tested. Both instruments use an FID to detect THC as it is combusted in a hydrogen flame. The FID for each instrument was calibrated using certified concentrations of methane in air.

FTIR measurements were conducted according to an operational protocol developed by Radian to meet the needs of the GRI Air Toxics program. A Nicolet Model RS-3 FTIR bench unit equipped with a gas cell adjusted to a path length of 10.8 meters was used to obtain maximum sensitivity for the compounds of interest while minimizing interferences from high concentrations of water and carbon dioxide. The cell had a 32-inch mirror spacing inside a 4-inch ID stainless steel tube (Infrared Analysis, Model 4-32-AU). Gold coated glass substrate mirrors were utilized to prevent degradation of the mirror surface due to moisture or any acid gases in the exhaust stream. The FTIR spectral data were recorded using a flow-through cell maintained at 365° F. The cell pressure was continuously monitored during the measurements. Instrumental resolution was set a 0.5 cm^{-1} for all runs.

Quantitation of the spectral data was based on reference spectra and Classical Least Squares and band area techniques. The reference spectra were generated by measuring certified gas standards containing the pollutants of interest at known concentrations. All reference spectra were measured at a cell temperature of 365° F and at known pressures.

B.2.4 Calibration and Quality Control Standard Delivery

The calibration and QC gas standards consisting of target analytes contained in high-pressure gas cylinders were introduced into the sampling system through a dedicated tube in the multi-tube heat-traced sample line. A solenoid valve located at the exit of the sampling probe was actuated to allow the gas standards to flow through the heat traced sample line, the heated head pump, the insulated sample manifold, and the gas conditioner as appropriate. Gas standards were delivered at a flow rate in excess of the total sample extraction flow rate.

Appendix C

Detailed QA/QC Summary

Campaign 1
Detailed QA/QC Summary

3.0 QUALITY ASSURANCE/QUALITY CONTROL

The goal of quality assurance/quality control (QA/QC) procedures is to ensure the collection of representative samples, control of data quality during sample analysis, and the use of valid data handling procedures to provide a link between the analytical results and the physical conditions they represent. This section describes the QA/QC procedures used in the field and laboratory. All raw data are included in the appendices.

3.1 Process Data Quality

Where available, process data were recorded at 30-minute intervals throughout each test period. At the end of each day, a copy of the process data collected was reviewed by the Radian field engineer.

3.2 CEM Data Quality

Quality assurance procedures for the CEM systems were implemented according to the reference methods. These specifications include requirements to determine calibration drift, relative accuracy, and relative error of the instruments. The primary method of measuring these parameters was daily analysis of control standards.

3.2.1 CEM Calibration Check

Analyzer calibration was performed at least once each test day. Analyzer response for O_2, NO_x, CO, THC, and CO_2 was set using zero- and high-level calibration gases introduced through the entire CEM system. Subsequent responses to mid-level QC gases are presented in Table 3-1.

3.2.2 CEM Drift Checks

Directly after the completion of monitoring each day, instrument specific mid-level QC gases were introduced through the entire CEM system and measured by the corresponding instrumentation to evaluate measurement drift. The percent drift of each instrument was determined by calculating the percent difference, relative to span, between the first and last mid-range QC check. No calculated drifts were outside the

Table 3-1

CEMS QC Data Summary

Date	Analyzer	Analyzer Range	QC Input	Units	Average Bias (%)	Response RSD (%)	Calibration Drift (%)
10/29	O_2	25	14.02	%	-2.88	1.96	2.00
	CO	50,000	15,020	ppm	-2.26	0.66	-0.33
			901	ppm	-0.238	–	
	CO_2	20	10.0	%	-0.38	1.35	1.35
	NO_x	2500	796	ppm	0.72	2.62	-1.31
	THC	10,000	917	ppm	3.33	--	0.02
			1402	ppm	2.09	--	
			497	ppm	-0.21	0.33	
10/30	O_2	25	14.02	%	-0.08	0.0	0.00
	CO	20,000	15,020	ppm	-4.78	1.04	-1.46
	CO_2	20	10.0	%	-1.00	1.02	-1.00
	NO_x	2500	796	ppm	-1.41	2.95	-1.48
	THC	10,000	497	ppm	-2.53	1.02	0.09
10/31	O_2	25	14.02	%	-0.08	0.71	-0.80
			3.00	%	-0.80	--	
	CO	20,000	15,020	ppm	-4.96	0.85	-0.85
		1000	5000	ppm	-2.96	0.32	
	CO_2	20	10.0	%	-1.33	1.57	-0.50
			3.49	%	-1.45	--	
	NO_x	2500	796	ppm	-1.04	2.00	-0.40
	THC	10,000	497	ppm	-1.39	1.82	-0.13
			1402	ppm	-4.82	--	
11/1	O_2	25	3.00	%	-0.40	--	0.80
			14.02	%	0.36	1.00	
	CO	1,000	500.0	ppm	-2.62	0.16	0.13
	CO_2	20	10.0	%	-1.00	--	0.00
			3.49	%	-1.45	0.00	
	NO_x	2500	796	ppm	-1.04	0.79	-0.34
	THC	10,000	497	ppm	-1.25	2.07	-0.14

Table 3-1

(Continued)

Date	Analyzer	Analyzer Range	QC Input	Units	Average Bias (%)	Response RSD (%)	Calibration Drift (%)
11/2	O_2	25	3.00	%	-0.40	--	-1.20
			14.02	%	-0.48	--	
	CO	1,000	500.0	ppm	-2.49	0.13	0.09
	CO_2	20	3.49	%	-1.45	--	NM
			10.0	%	-0.50	--	
	NO_x	2,500	248	ppm	-0.12	1.5	-0.21
	THC	10,000	497	ppm	0.06	0.94	-0.07
11/3	O_2	25	14.02	%	-0.08	--	0.00
			3.00	%	-0.40	0.0	
	CO	1,000	500.0	ppm	-2.89	0.58	-0.55
	CO_2	20	10.0	%	-1.00	--	0.00
			3.49	%	-1.45	0.0	
	NO_x	2,500	248	ppm	0.16	0.42	0.06
	THC	10,000	917	ppm	0.99	--	-0.04
			497	ppm	0.37	0.52	
11/4	O_2	25	14.02	%	-0.20	0.30	-0.24
	CO	20,000	15020	ppm	-1.93	1.37	1.41
	CO_2	20	10.0	%	-1.08	0.22	-0.15
	NO_x	2,500	248	ppm	0.17	1.29	0.18
	THC	10,000	497	ppm	3.38	0.22	-0.02

specified range of ± 3%. Table 3-1 summarizes the drift results for the criteria pollutant CEM analyzers.

3.2.3 CEM Relative Accuracy and Precision

Immediately after completion of instrument calibration, an instrument specific QC standard at the approximate concentration expected in the source gas was introduced through the entire CEM system and measured by the corresponding instrumentation. The percent difference between the measured concentration of the QC standard and the known concentration for each species was calculated to quantify measurement bias (accuracy). For O_2, CO_2, CO, and NO_x, the percent difference is calculated relative to instrument span. For THC, the percent difference is calculated relative to QC input. This procedure was repeated periodically throughout each test day to calculate an average of response values.

The relative standard deviation (RSD) was calculated for the multiple QC checks to provide an indication of the precision (repeatability) of the species measurements. The RSD is calculated by taking the ratio of the response standard deviation to the average of the response values.

Table 3-1 summarizes the measurement bias and precision for each of the criteria pollutant analyzers on each test day. As shown in the table, all measured biases were within the acceptable range of ±10 percent, with only 12 of 97 bias measurements greater than 3 percent. Precision measurements were all within the specified range of 5 percent. Only 3 of 34 precision measurements were greater than 3 percent.

3.2.4 FTIR Data Quality

The FTIR instrument does not require introduction of a span gas for each species measured. Quantitation is based on reference spectra representing each of the species measured at that temperature and concentration.

Daily analysis of a control standard was used to determine the measurement bias of the FTIR. Table 3-2 presents the results of the FTIR QC activities. All but 5 of the 36 QC checks were within the acceptable ± 15 percent range specified in the test plan.

Table 3-2

FTIR QA Data Summary

Date	Compound	QC Input	FTIR Output	% Bias
10/30/93	Acetaldehyde	1.0	1.02	2.0
		1.0	0.97	-3.0
	Benzene	1.0	1.09	9.0
		1.0	1.07	7.0
	Toluene	1.1	1.13	2.7
		1.1	1.15	4.5
10/31/93	Acetaldehyde	1.0	0.88	-12.0
		1.0	1.10	10.0
		1.0	1.15	15.0
	Benzene	1.0	1.07	7.0
		1.0	1.05	5.0
		1.0	0.93	-7.0
	Toluene	1.1	1.08	-1.8
		1.1	1.08	-1.8
		1.1	0.95	-12.8
11/1/93	Acetaldehyde	1.0	0.96	-4.0
		1.0	1.0	0.0
	Benzene	1.0	1.05	5.0
		1.0	1.05	5.0
	Toluene	1.1	1.08	-0.9
		1.1	0.99	-9.2
11/2/93	Acetaldehyde	1.0	0.74	-26.0
		1.0	1.30	30.0
	Benzene	1.0	0.99	-1.0
		1.0	1.07	7.0
	Toluene	1.1	0.99	-9.2
		1.1	1.11	1.8

Table 3-2

(Continued)

Date	Compound	QC Input	FTIR Output	% Bias
11/3/93	Acetaldehyde	1.0	0.81	-19.0
		1.0	1.16	16.0
		1.0	1.48	48.0
	Benzene	1.0	1.02	2.0
		1.0	1.05	5.0
		1.0	1.08	8.0
	Toluene	1.1	1.09	0.0
		1.1	1.12	2.8
		1.1	1.18	8.3

3.3 Manual Sampling Data Quality

Quality control for the manual sampling and analysis methods consisted of the following procedures: field blank samples, field spiked samples, replicate samples, laboratory matrix spike and matrix spike duplicates (MS/MSD), and laboratory control samples.

3.3.1 CARB Method 430 Data Quality

Table 3-3 presents the results of duplicate analyses for the CARB Method 430. The relative percent difference of all measurements were within the ± 20 percent range specified in the test plan.

Three different types of spike recovery data were collected for CARB Method 430 QA purposes:

- laboratory matrix spikes;
- laboratory trip spikes; and
- laboratory spikes.

A laboratory matrix spike adds a known quantity of spiking solution to a sample which was already recovered in the field. The spiked material reacts with any excess DNPH in the samples. This evaluates the presence of interfering constituents in the recovered spike solution. Laboratory trip spikes are samples prepared in the lab, shipped to the test site with the DNPH solutions, recovered on-site, and shipped back to the lab. These spikes can identify possible interference due to sample handling. The laboratory spike is performed in the lab to check the accuracy of analytical equipment.

Table 3-4 presents the spike recovery data. All but 7 of the 40 recoveries were within the range of 75 to 125% as specified in the test plan. Four of the seven exceedances were caused by matrix effects.

Table 3-3

CARB Method 430 Duplicate Results

Compound	1 (μg)	2 (μg)	RPD (%)
Formaldehyde			
9311052A	140	120	15.4
9311052B	220	220	0.0
9311013A	32	29	9.8
9311013B	37	43	15.0
9311013C	35	34	2.9
9311013D	ND	ND	0.0
9311013E	ND	ND	0.0
Acetaldehyde			
9311052B	13	11	16.7
9311052B	22	23	4.4
9311013A	4.5	3.9	14.3
9311013B	1.6	1.9	17.1
9311013C	2.2	2.2	0.0
9311013D	ND	ND	0.0
9311013E	ND	ND	0.0
Acrolein			
9311052B	4.7	3.9	18.6
9311052B	3.3	3.6	8.7
9311013A	0.82	0.76	7.6
9311013B	ND	ND	0.0
9311013C	0.51	0.56	9.3
9311013D	ND	ND	0.0
9311013E	ND	ND	0.0
Butyraldehyde/Isobutyraldehyde			
9311052B	ND	ND	0.0
9311052B	ND	ND	0.0
9311013A	ND	ND	0.0
9311013B	ND	ND	0.0
9311013C	ND	ND	0.0
9311013D	ND	ND	0.0
9311013E	ND	ND	0.0

Table 3-4

CARB Method 430 Spike Recovery Data

Trip Spike	Formaldehyde	Acetaldehyde	Acrolein
9311052B	86	95	NS
9311013A	127	83	NS
Matrix Spike			
9311052B	94	99	95
9311052B	0Q	0Q	0Q
9311013A	101	68Q	106
9311013B	99	78	105
9311013C	101	76	106
9311013D	76	72	100
Lab Spike			
9311052B	98	92	86
9311013A	100	82	101
9311013B	80	68E	106
9311013C	74E	62E	95
9311013D	146E	94	104
9311013E	106	93	104

NS = Not sampled.

Q = Exceeds quality control limits due to matrix effects.

E = Exceeds quality control limits.

3.3.2 SW-846 Method 0030 (VOST) Data Quality

Table 3-5 presents the results of the duplicate analyses. All relative percent differences and standard deviations were within the ± 20% range specified in the test plan. Table 3-6 presents the recovery data during this campaign. All recoveries were within the 70 to 130% range specified in the test plan.

Table 3-5

SW-846 Method 0030 Duplicate Analysis

	Duplicate 1 (µg)	Duplicate 2 (µg)	Duplicate 3 (µg)	RSD (%)
9311052A				
Benzene	4700	6300	6600	17.4
Toluene	1900	2700	2600	18.2
Ethylbenzene	200	260	250	13.6
Xylene	830	1180	1140	18.2
9311028				
Benzene	11000	9600	--	13.6
Toluene	3400	3400	--	0.0
Ethylbenzene	340	230	--	4.3
Xylene	760	770	--	1.3

RPD = Relative percent difference.

RSD = Relative standard deviation.

Table 3-6

SW-846 Method 0030 QA Data
Recovery (%)

Sample	9311028	9311052A
Benzene	102	96
Toluene	105	95
Ethylbenzene	100	91
Xylene	101	92

3.3.3 SW-846 Method 0010 (SemiVOST) Data Quality

Table 3-7 presents the surrogate recovery data for each testing period. All recoveries were in the 70 to 130% range specified in the test plan. All isokinetic and leak check results were within acceptable limits (± 10% isokinetics, <0.02 acfm leak rate).

Table 3-7

SW-846 Method 0010 QA Data
Recovery (%)

Compound	Sample Number							
	F9759	F9762	F9813	F9765	F9814	F9763	F9766	F9764
2-Fluorobiphenyl	91	87	88	94	82	74	87	85
2-Flurophenol	98	84	79	102	78	81	89	87
Nitrobenzene-d_5	107	106	86	111	79	90	106	96
Phenol-d_5	102	91	80	105	80	83	105	94
Terphenyl-d_5	94	91	88	104	86	77	94	93
2,4,6-Tribromophenol	93	98	91	104	86	71	89	94

3.3.4 SW-846 Method 0012 (Metals) Data Quality

Table 3-8 presents the recovery data for each testing period. All recoveries were within the 75 to 125% range specified in the test plan. All isokinetic and leak check results were within acceptable limits (±10% isokinetics, <0.02 acfm leak rate).

Table 3-8

SW-846 Method 0012 Recovery Data
Recovery (%)

Compound	03A-AS	03-ASD	04A-AS	04-ASD
Antimony	84	82	81	79
Arsenic	82	85	84	82
Beryllium	88	88	88	87
Cadmium	85	85	85	84
Chromium	89	88	88	87
Cobalt	86	86	86	85
Lead	86	87	86	87
Nickel	86	87	87	87
Selenium	85	84	86	81

Campaign 3
Detailed QA/QC Summary

5.0 QUALITY ASSURANCE/QUALITY CONTROL AND DOCUMENTATION

The goal of the quality assurance/quality control (QA/QC) procedures is to ensure the collection of representative samples, control of data quality during sample analysis, and the use of valid data handling procedures to provide a link between the analytical results and the physical conditions they represent. This section describes the QA/QC procedures used in the field and laboratory. Tables of results are presented at the end of this section, following the text.

5.1 Process Data Quality

At the end of each day, a copy of the process data collected was reviewed by the Radian field engineer. In addition, an engine analyst was on-site during testing at Station 3B to verify engine operating conditions and identify engine upsets. No upsets were noted.

5.2 Continuous Emission Monitors Data Quality

Quality assurance procedures for the CEM systems were implemented according to the reference methods. These specifications include requirements to determine calibration drift, relative accuracy, and relative error of the instruments. The primary method of measuring these parameters was daily analysis of control standards.

5.2.1 CEM Calibration Check

Analyzer calibration was performed at least once each test day. Analyzer response for NO_x, CO, THC, and CO_2 was set using zero and high-level calibration gases introduced through the entire CEM system. Due to the measurement principle used by the O_2 analyzer, a small concentration of O_2 must be present in order to achieve a proper low-range response. A calibration gas containing 2.0% O_2 was used in place of a zero gas for this analyzer. Subsequent response to mid-level QC gases was within 2.0% of the span value, as required by the test plan.

5.2.2 CEM Drift Checks

Directly after the completion of monitoring each day, instrument-specific zero and high-level QC gases were introduced through the entire CEM system and measured by the corresponding instrumentation to evaluate measurement drift. The percent drift of each instrument was determined by calculating the percent difference between the pre-sampling and post-sampling measured values for the QC standards. Calculated calibration drift for all analyzers (except CO_2) was less than 10%, as specified in the test plan. During this campaign, the CO_2 analyzer was malfunctioning, therefore, FTIR was used to monitor CO_2. levels. For all but 7 of 65 span drift checks and for all zero drift checks, the calculated drift was less than 2 percent. Table 5-1 summarizes the drift calculations for the criteria pollutant CEMs.

5.2.3 CEM Relative Accuracy and Precision

Directly after completion of instrument calibration, an instrument-specific QC standard at the approximate concentration expected in the source gas was introduced through the entire CEM system and measured by the corresponding instrumentation. The percent difference between the measured concentration of the QC standard and the known concentration for each species was calculated to verify the absence of measurement bias (accuracy). This procedure was repeated periodically throughout each test day to calculate an average bias for each species measurement. The relative standard deviation was calculated for the multiple QC checks to provide an indication of the precision (repeatability) of the species measurements.

Table 5-1 summarizes the measured bias for each of the criteria pollutants on each test day. These calculations showed the criteria pollutant bias to be less than 10%, as required in the test plan, for all pollutants except CO_2. The average CO_2 bias exceeded 10% on three days due to electronic malfunction by the CO_2 instrument response linearization components. Due to this malfunction, the CO_2 analyzer could not correctly interpolate measurements between the zero and span values. During this campaign, FTIR measurements of CO_2 were used due to the malfunction in the CEM CO_2 analyzer.

The precision measurement for CO_2 was outside the specified level of 5% on two days, for NO_x on one day, and for CO on one day. All other precision measurements were within the specified range.

5.2.4 FTIR Data Quality

The FTIR does not require introduction of a span gas for each species measured. Quantitation is based on reference spectra representing each of the species measured at that temperature and pressure.

Daily analysis of control standards was used to determine the bias of the FTIR measurements. Table 5-2 presents the results of FTIR QC activities. QC results from acetaldehyde, benzene, toluene, and 1,3-butadiene were unavailable due to an error in the certified calibration gas concentration. Only one of eight QC checks was outside of the ±10 percent acceptance range. Injections of halocarbon 22 were used to calibrate the instrument pathlength.

5.3 Manual Sampling Methods Data Quality

Quality control procedures for the manual sampling and analysis methods consisted of the following procedures: field blank samples, field spiked samples, replicate samples, matrix spike and matrix spike duplicates (MS/MSD), and laboratory control sample and laboratory control sample duplicates (LCS/LCSD).

5.3.1 CARB Method 430 Data Quality

Table 5-3 shows the results of duplicate analyses for the CARB 430 method. The relative standard deviation of these measurements is within the 20% specified in the test plan for each compound.

Five different types of spike recovery data are collected for CARB Method 430 QA purposes:

- sample spikes;
- laboratory matrix spikes;
- field spikes;

- laboratory trip spikes; and
- laboratory spikes.

The sample spikes and field spikes are performed on-site by the sampling team. In both cases, a known quantity of formaldehyde is added to a set of impingers, then the spiked impinger solutions are recovered following the standard sample recovery procedure. In the case of a sample spike, the formaldehyde is added to the third set of impingers from a normal run triplicate set after all three sets of impingers have been exposed to flue gas. This allows a QA check for interference from flue gas constituents, as well as a check of the sample recovery procedure. The field spike involves adding a known quantity of formaldehyde to the impinger solutions in an assembled sampling train which has not been exposed to the flue gas. This approach provides a check of sample recovery quality.

A laboratory matrix spike adds a known quantity of spiking solution to a sample which was already recovered in the field. The spiked material reacts with any excess DNPH in the samples. This evaluates the presence of interfering constituents in the recovered spike solution. Laboratory trip spikes are samples prepared in the lab, shipped to the test site with the DNPH solutions, recovered on-site, and shipped back to the lab. These spikes can identify possible interference due to sample handling. The laboratory spike is performed in the lab to check the accuracy of analytical equipment.

Table 5-4 summarizes the sample spike recoveries. Each of the sample spikes achieved a recovery of less than 1 percent. The chromatograms of these samples indicate an unusually low excess DNPH solution peak, and several unidentified peaks. This suggests the presence of compounds in the flue gas with which the DNPH reacts preferentially over the aldehyde compounds.

Table 5-5 summarizes the remaining spike recovery data. Most of these recoveries fall within the 70% to 130% quality control limits established by the method. Two of the laboratory matrix spike recoveries were outside this range. The chromatograms for both of these samples exhibited small DNPH peaks, which suggests the spiked amount exceeded the quantity of excess DNPH available for reaction. In these cases, the formaldehyde recovery is lower than that for the other aldehydes due to the slower rate of reaction for formaldehyde with DNPH as compared to the other aldehydes. It is unclear what caused the low field spike recovery and low trip spike recovery observed in samples GRI3-430-39 and GRI3-430-118, respectively.

5.3.2 Method 0010 Data Quality

Quality assurance data for the four semivolatile organic compound runs are shown in Table 5-6. Isokinetic sampling and leak checks were all within acceptable limits (± 10% isokinetics, <0.02 acfm leak rate). Analysis of the field blank sample yielded background levels of target compounds which were all less than 4% of the lowest measured quantity in the samples, as shown in Table 5-7. This indicates good resolution for detected compounds. The semivolatile compound results were not blank corrected.

5.3.3 Method 18 Data Quality

The quality control procedures specified in Method 18 were followed. The retention time of the analytes of interest were determined using certified calibration gases. Calibration curves were developed for the quantitation of all analytes, and the calibration drift was checked at the end of each test day. Table 5-8 summarizes the Method 18 GC calibration data.

5.3.4 Method 201A Data Quality

Table 5-9 summarizes the sampling QA data for the four particulate matter runs. All runs were sampled within the 80-120% isokinetic range specified by EPA Method 201A. The calculated aerodynamic diameter cut points were all above 11 microns, which means that the PM_{10} emission rates may be biased high.

Table 5-1

CEM QC Data Summary

Date	Analyzer	Range	QC Input	Units	Average Bias[a]	Response RSD[b] (%)	Calibration Drift[c] Zero (%)	Span (%)
6/14/94	THC	10,000	917	ppmv	1.56	0.44	-0.06	-0.11
			1402		-0.88	--		
	CO	1,000	350	ppmv	-1.52	--	-0.01	-0.69
			500		-3.29	0.85		
	CO_2	20	3.49	%	0.75	18.07	-0.21	-0.67
			7.49		-3.3	14.06		
	NO_x	10,000	936	ppmv	0.54	5.21	0.05	-0.63
			1978		-0.15	--		
	O_2	25	2.01	%	0.32	--	0.18	0.12
			3		-0.03	0.57		
			7.5		0.0	0.13		
6/15/94	THC	10,000	917	ppmv	5.21	--	0.06	-0.15
			1402		1.48	0.95	0.03	0.18
							0.07	0.22
	CO	1,000	350	ppmv	-0.64	15.72	-0.02	-1.36
			500		-2.75	--	-0.00	0.25
							0.01	-0.37
	CO_2	20	3.49	%	2.95	--	-0.23	0.59
			7.49		3.08	0.43	0.43	1.15
							-0.28	-0.15
	NO_x	1,000	936	ppmv	0.51	2.44	-0.05	-6.94
							0.13	4.11
							-0.09	-1.90
	O_2	25	3	%	-0.04	--	0.03	-0.34
			7.5		0.06	0.07	-0.05	0.20
							0.04	-0.10
6/16/94	THC	10,000	917	ppmv	1.72	--	0.05	-0.28
			1402		0.93	--		
	CO	1,000	350	ppmv	-0.57	0.44	-0.01	-1.47
			500		-2.80	--		
	CO_2	20	3.49	%	2.55	--	-0.16	-0.13
			7.49		2.88	2.91		
	NO_x	10,000	936	ppmv	0.82	--	0.15	-6.16
			2005		-0.09	2.53		
	O_2	25	3	%	0.04	--	0.13	-0.84
			7.5		0.04	0.13		

Table 5-1

(Continued)

Date	Analyzer	Range	QC Input	Units	Average Bias[a]	Response RSD[b] (%)	Calibration Drift[c] Zero (%)	Span (%)
6/18/94	THC	10,000	917	ppmv	0.54	0.56	0.05	-0.62
			2003		0.29	1.28	-0.07	-0.44
							-0.09	-1.14
							0.40	0.91
	CO	1,000	350	ppmv	-0.44	0.27	-0.02	-0.99
							-0.01	-0.47
							-0.01	-0.47
							-0.20	-0.23
	CO_2	20	7.49	%	2.71	0.30	0.23	0.18
							-0.00	0.73
							-0.00	0.73
							0.08	-1.01
	NO_x	10,000	248	ppmv	0.18	0.74	0.23	-2.83
			2005		0.18	0.37	-0.22	-0.54
							-0.22	-0.54
							0.04	0.37
	O_2	25	7.5	%	-0.07	0.20	0.19	-0.34
							0.06	-0.29
							0.06	-0.29
							0.10	-0.00
6/19/94	THC	10,000	917	ppmv	-0.89	0.08	-0.09	1.10
							0.11	-0.74
							-0.03	0.02
	CO	1,000	350	ppmv	-0.70	1.91	-0.01	-0.71
							-0.01	-0.13
							0.00	0.34
	CO_2	20	7.49	%	4.31	9.02	-0.14	-0.74
							-0.24	21.15
							-0.13	-3.93
	NO_x	10,000	936	ppmv	0.65	0.30	0.03	0.07
							0.21	-1.00
							-0.06	0.25
	O_2	25	7.5	%	0.05	0.24	-0.00	-0.30
							0.05	-0.39
							-0.04	-0.00

Table 5-1

(Concluded)

Date	Analyzer	Range	QC Input	Units	Average Bias[a]	Response RSD[b] (%)	Calibration Drift[c] Zero (%)	Calibration Drift[c] Span (%)
6/20/94	THC	10,000	917	ppmv	2.09	0.07	-0.69	-0.62
	CO	1,000	350	ppmv	0.05	-0.01	-0.58	-0.44
	CO_2	20	7.49	%	0.00	0.06	0.14	-1.14
	NO_x	10,000	936	ppmv	1.13	0.11	-4.24	0.91
	O_2	25	7.5	%	0.13	0.11	-0.58	-0.99

[a] Bias = $\frac{\text{Instrument Response - QC Input}}{\text{Range}}$ * 100 for CO, CO_2, NO_x, O_2,

Bias = $\frac{\text{Instrument Response - QC Input}}{\text{QC Input}}$ X 100 for THC

[b] Response RSD = % Relative Standard Deviation measured in the instrument response to multiple injections of a given QC gas.

[c] Drift measured as percent of full scale.

Table 5-2

FTIR QC Data Summary

Date	Time	Compound	QC Input (ppmv)	FTIR Output (ppmv)	Bias (%)
6/15/94	1835	Methane	1,402	1,285	-8.3
6/18/94	1940	Methane	2,003	1,735	-13.4
6/19/94	2040	Methane	917	875	-4.6
6/20/94	1840	Carbon Dioxide	74,900	74,055	-1.1
		Methane	917	897	-2.2

Table 5-3

CARB Method 430 Duplicate Analytical Results

Sample	Analyte	Dup 1 (ug)	Dup2 (ug)	RSD (%)
GRI3-430-04	Formaldehyde	0.29	0.26	5.5
	Butyraldehyde	0.14	0.1	16.7
GRI3-430-22	Formaldehyde	0.99	1.1	5.3
	Butyraldehyde	0.25	0.21	8.7
GRI3-430-44	Formaldehyde	0.29	0.32	4.9
	Butyraldehyde	0.21	0.27	12.5
	Propanal	0.1	0.12	9.1
	Acetaldehyde	ND	0.11	---
GRI3-430-62	Formaldehyde	0.69	0.69	0.0
	Butyraldehyde	0.34	0.36	2.9
	Propanal	ND	0.1	---
GRI3-430-84	Formaldehyde	0.18	0.23	12.2
	Butyraldehyde	0.6	0.82	15.5
	Propanal	0.43	0.3	17.8
	Acetaldehyde	0.62	0.42	19.2
GRI3-430-102	Formaldehyde	38	33	7.0
	Acetaldehyde	10	9.1	4.7
	Acrolein	10	8.9	5.8
	Butyraldehyde	1.8	1.5	9.1
	Propanal	1.8	1.6	5.9

RSD = Relative Standard Deviation

Table 5-4

CARB Method 430 Sample Spike Recovery Data

Engine No.	Mass (ug) of Formaldehyde Spiked into Third Set	Set One		Set Two		Average Mass of Sets 1 & 2 (ug)	Set Three		Percent Of Spike Recovered
		Sample ID Number	Mass of Formaldehyde Detected (ug)	Sample ID Number	Mass of Formaldehyde Detected (ug)		Sample ID Number	Mass of Formaldehyde Recovered (ug)	
102	600	GRI3-430-22	1	GRI3-430-28	1	1	GRI3-430-34	0.57	<1
101	600	GRI3-430-62	0.7	GRI3-430-68	0.5	0.6	GRI3-430-74	0.53	<1
2	400	GRI3-430-102	38	GRI3-430-108	16	27	GRI3-430-114	9.4	<1

Table 5-5

CARB Method 430 Spike Recovery Data

Sample ID Number	Formaldehyde	Acetaldehyde	Acrolein
Laboratory Matrix Spike Recoveries			
GRI3-430-10	83	97	93
GRI3-430-28	83	84	96
GRI3-430-50	88	79	95
GRI3-430-68	57 Q	56 Q	87
GRI3-430-90	83	94	95
GRI3-430-108	9 Q	91	77
Radian Field Spike Recoveries			
GRI3-430-39	64 Q	--	--
GRI3-430-40	77	--	--
GRI3-430-119	76	--	--
GRI3-430-120	73	--	--
GRI3-430-121	78	--	--
Laboratory (Trip) Spike Recoveries			
GRI3-430-37	74	74	--
GRI3-430-123	87	72	--
GRI3-430-118	69 Q	65 Q	--
Laboratory (Lab) Spike Recoveries			
Site A	91	85	78
Site B	88	83	92

Q - Exceeds quality control limits of 70% to 130%.

Table 5-6

Method 0010 Isokinetic Sampling and Leak Check Results

Date	Run Time	Engine	Percent Isokinetic	Initial Leak Rate	Final Leak Rate
6/14/94	1600-1920	102	95.1	0.000 @10"Hg	0.011 @ NR
6/16/94	0926-1222	101	100.5	0.004 @11"Hg	0.000 @15"Hg
6/20/94	1007-1345	2	100.9	0.002 @ NR	0.010 @18"Hg
6/20/94	1605-2023	2	103.5	0.004 @12"Hg	0.011 @ NR

NR = Not Recorded

Table 5-7

Method 0010 Field Blank Results

Compound	Blank Quantity (ug)	Lowest Sample Quantity (ug)	Percent of Lowest Sample Quantity
Naphthalene	0.91	26.6	3.4%
Phenol	0.79	31.8	2.5%
Dibenzofuran	ND	ND	---
Acetophenone	1.48	42.7	3.5%
Biphenyl	ND	ND	---

ND = Not Detected

Table 5-8

Method 18 Calibration Data Summary

Date	Initial/Final	C1 Response	C2 Response	C3 Response	C4 Response	C5 Response	C6 Response
6/14/94	Linearity	0.99995	0.99997	0.99998	0.99996	0.99996	0.99993
	Drift (%)	1.3	1.3	1.6	0.5	-0.3	-0.6
6/15/94	Linearity	0.99986	0.99998	0.99995	0.99997	0.99996	0.99993
	Drift (%)	-4.6	-4.3	-4.0	-5.3	-5.2	-6.7
6/16/94	Linearity	0.99992	0.99999	0.99990	0.99995	0.99995	0.99995
	Drift (%)	6.3	5.1	3.4	1.3	0.7	-0.3
6/18/94	Linearity	0.99978	0.99985	0.99986	0.99987	0.99984	0.99987
	Drift (%)	10.4	10.6	9.8	9.0	11.0	12.6
6/19/94	Linearity	0.99996	0.99994	1.00000	0.99997	0.99993	0.99997
	Drift (%)	10.0	9.5	7.3	4.4	-0.8	-3.1

Table 5-9

Method 201A Isokinetic Sampling and Leak Check Results

Date	Run Time	Engine	Percent Isokinetic	Initial Leak Rate	Cut Point (microns)
6/15/94	0905-1301	102	95.3	0.004 @10"Hg	11.7
6/16/94	1345-1755	101	84.5	0.006 @15"Hg	12.2
6/19/94	1027-1422	2	104.6	0.004 @16"Hg	11.3
6/19/94	1628-2017	2	108.4	0.002 @12"Hg	11.1

Campaign 4
Detailed QA/QC Summary

5.0 QUALITY ASSURANCE/QUALITY CONTROL AND DOCUMENTATION

The goal of the quality assurance/quality control (QA/QC) procedures is to ensure the collection of representative samples, control of data quality during sample analysis, and the use of valid data handling procedures to provide a link between the analytical results and the physical conditions they represent. This section describes the QA/QC procedures used in the field and laboratory. Tables of results are presented at the end of this section, following the text.

5.1 Process Data Quality

At the end of each day, a copy of the process data collected was reviewed by the Radian field engineer. In addition, an engine analyst was on-site during testing to verify engine operating conditions and identify engine upsets. Several facility power outages were experienced during the tests. These time periods were excluded from data analysis.

5.2 Continuous Emission Monitors Data Quality

Quality assurance procedures for the CEM systems were implemented according to the reference methods. These specifications include requirements to determine calibration drift, relative accuracy, and relative error of the instruments. The primary method of measuring these parameters was daily analysis of control standards.

Due to the wide range in NO_x concentrations across the SCR and NSCR catalysts, the NO_x analyzer was calibrated over the 0-10,000 ppmv range. During tests where NO_x levels were lower, the analyzer range was switched to a 0-100 or 0-1,000 ppmv range. Once the instrument was calibrated at the 0-10,000 ppmv range, it would also remain linear over the 0-100 and 0-1,000 ppmv ranges. Several mid-range QC checks were performed at the lower ranges to confirm instrument accuracy.

5.2.1 CEM Calibration Check

Analyzer calibration was performed at least once each test day. Analyzer response for NO_x, CO, THC, and CO_2 was set using zero and high-level calibration gases introduced through the entire CEM system. Due to the measurement principle used by the O_2 analyzer, a small concentration of O_2 must be present in order to achieve a proper low-range response. A calibration gas containing 2.0% O_2 was used in place of a zero gas for this analyzer. Subsequent responses to mid-level QC gases are recorded in Table 5-1.

5.2.2 CEM Drift Checks

Directly after the completion of monitoring each day, instrument specific zero and high-level QC gases were introduced through the entire CEM system and measured by the corresponding instrumentation to evaluate measurement drift. The percent drift of each instrument was determined by calculating the percent difference between the pre-sampling and post-sampling measured values for the QC standards. Calculated calibration drift for all analyzers was less than 10%, as specified in the test plan. For all but 2 of 40 span drift checks and 1 of 40 zero drift checks, the calculated drift was less than 2 percent. Table 5-1 summarizes the drift calculations for the criteria pollutant CEMs.

5.2.3 CEM Relative Accuracy and Precision

Directly after completion of instrument calibration, an instrument-specific QC standard at the approximate concentration expected in the source gas was introduced through the entire CEM system and measured by the corresponding instrumentation. The percent difference between the measured concentration of the QC standard and the known concentration for each species was calculated to verify the absence of measurement bias (accuracy). This procedure was repeated periodically throughout each test day to calculate an average bias for each species measurement. The relative standard deviation was calculated for the multiple QC checks to provide an indication of the precision (repeatability) of the species measurements.

Table 5-1 summarizes the measured bias for each of the criteria pollutants on each test day. These calculations showed the criteria pollutant biases, except for two to be less than 10%, as required in the test plan, for all pollutants, and less than 5% for all but nine bias checks.

Table 5-1

CEMS QC Data Summary

Date	Compound	Analyzer Range	QC Input	Average Bias (%)	Response RSD	Calibration Drift Zero (%)	Calibration Drift Span (%)
8-23	O_2	25	20.9	-1.20		0.24	-1.20
		25	14	-0.40	0.71		
		25	10	-0.10	0.96		
		25	2	0.00	0.00		
	CO_2	20	18	0.00		0.04	0.00
		20	10	-0.95	0.17		
		20	7	0.25	0.82		
	CO	20,000	20,000	-0.82		0.13	-0.82
		20,000	15,100	0.77	0.58		
		20,000	10,300	-2.55	0.61		
		20,000	100	-0.06			
	NO_x	10,000	5,003	1.93		0.02	1.93
		10,000	938	0.35	5.05		
		10,000	509	0.09	3.72		
	THC	10,000	9,026	-1.41		1.18	-1.28
		10,000	2,003	7.04			
		10,000	917	6.00	6.73		
		10,000	497	14.3	5.26		
8-24	O_2	25	20.9	-0.40		0.33	-0.55
		25	9.99	-0.36			
		25	2	0.00			
	CO_2	20	18	0.00		0.31	0.06
		20	7	0.50			
	CO	20,000	20,000	-0.82		0.03	-1.00
		20,000	10,300	-3.23			
	NO_x	10,000	5,003	0.31		0.05	0.13
	THC	10,000	9,026	0.66		0.19	-1.37
		10,000	2,003	2.30			
		10,000	938	3.09			

Table 5-1

(Continued)

Date	Compound	Analyzer Range	QC Input	Average Bias (%)	Response RSD	Calibration Drift	
						Zero (%)	Span (%)
8-25	O_2	25	20.9	1.40	0.34	-0.15	0.45
		25	14	0.00			
		25	10	0.00	1.00		
	CO_2	20	18	-1.50	0.00	0.01	-0.32
		20	10	-2.00			
		20	7	-0.67	0.82		
	CO	20,000	20,000	0.27	0.03	4.30	0.25
		20,000	15,000	2.05			
		20,000	10,300	-2.13	0.64		
	NO_x	10,000	5,003	-1.03	2.90	-0.01	-0.78
		10,000	938	0.00	2.90		
		10,000	509	0.00	3.12		
	THC	10,000	9,026	-0.343	0.96	-0.40	-0.53
		10,000	2,000	-0.60	1.17		
		10,000	917	-12.6	12.11		
8-26	O_2	25	20.9	-0.80	0.68	-0.66	-1.03
		25	14	-0.40			
		25	10	-0.67	0.58		
	CO_2	20	18	0.75	0.39	-0.26	0.26
		20	15	0.50			
		20	10	0.50			
		20	7	0.45	0.74		
	CO	100	99	-6.00		-0.14	-1.90
		100	90	-1.90			
	NO_x	10,000	5,003	0.25	0.25	-0.02	0.74
		10,000	938	0.16	0.45		
		10,000	509	0.05	1.29		
		100	77.5	-6.0			
	THC	10,000	9,026	0.52	0.09	0.00	-0.07
		10,000	2,003	2.40	1.45		
		10,000	917	0.55	1.48		

Table 5-1

(Continued)

Date	Compound	Analyzer Range	QC Input	Average Bias (%)	Response RSD	Calibration Drift Zero (%)	Calibration Drift Span (%)
8-27	O_2	25	20.9	-0.60	2.37	0.44	0.90
		25	10	-0.27	1.15		
		25	3	-0.20	2.36		
	CO_2	20	18	0.75	0.39	-0.06	0.46
		20	15	0.00			
		20	7	0.50	0.00		
		20	3.5	0.00	0.00		
	CO	500	500	-0.50	0.14	1.80	-0.55
		500	99.7	-0.09	0.78		
		500	91	-1.34			
	NO_x	10,000	5,003	0.31	0.62	0.02	-0.29
		10,000	938	0.21	0.80		
		1,000	509	1.3	0.90		
		100	78	6.0			
	THC	10,000	9,026	-0.06	0.53	-0.04	-0.29
		10,000	2,003	1.65	1.85		
		10,000	917	-0.98	1.65		
8-28	O_2	25	20.9	-0.80		-0.95	-1.00
		25	15	-0.40			
		25	10	-0.40	0.00		
		25	3	0.00	4.71		
	CO_2	20	18	-1.00		-0.14	-0.75
		20	7	-0.50	2.02		
		20	3.5	0.00	0.00		
	CO	500	500	1.00		-0.45	4.84
		500	100	-0.64			
		500	90	-1.24			
	NO_x	10,000	509	0.13	0.28	-0.01	0.26
		10,000	78	0.05			
	THC	10,000	9,026	0.40		0.38	-0.01
		10,000	917	1.09	0.47		

Table 5-1

(Continued)

Date	Compound	Analyzer Range	QC Input	Average Bias (%)	Response RSD	Calibration Drift Zero (%)	Calibration Drift Span (%)
8-29	O_2	25	20.9	-1.00	0.34	0.44	1.40
		25	10	0.00	0.00		
		25	3	0.00			
	CO_2	20	18	1.00	0.00	0.16	0.21
		20	15	0.00	0.00		
		20	7	0.33	0.82		
		20	3.5	0.50			
	CO	500	500	-4.10	2.12	0.35	-5.60
		500	99	-0.62			
		500	90	-1.70	2.99		
	NO_x	10,000	5,003	0.21	0.49	0.02	-0.13
		1,000	509	1.3	1.01		
		100	78	6.0	3.63		
	THC	10,000	9,026	-0.11	0.06	0.28	0.32
		10,000	2,003	4.29			
		10,000	917	-0.76	1.36		
8-30	O_2	25	20.9	-1.40	0.34	-0.36	-1.60
		25	10	-0.40	0.00		
		25	3	-0.40	0.00		
	CO_2	20	18	-0.75	0.39	-0.05	-1.00
		20	15	-1.00			
		20	7	0.00	0.00		
		20	3.5	0.00	0.00		
	CO	500	500	5.00		0.03	NR
		500	90	-0.72	0.63		
	NO_x	10,000	5,003	0.00	0.57	-0.01	-0.20
		1,000	509	0.1			
		100	78	5.0	0.54		
	THC	10,000	9,026	-0.03	0.52	0.18	0.31
		10,000	2,003	0.55	0.71		
		10,000	917	-2.62	0.85		

The precision measurement for THC was outside the specified level of 5% on two days, and for NO_x on one day. All other precision measurements were within the specified range.

5.2.4 FTIR Measurements

The FTIR instrument does not require introduction of a span gas for each species measured. Quantitiation is based on reference spectra representing each of the species measured.

Daily analysis of control standards was used to determine the bias of the FTIR measurements. Table 5-2 presents the results of FTIR QC activities. Of the 19 QC checks, only 4 were outside the acceptable ±10 percent range.

5.3 Manual Sampling Methods Data Quality

Quality control procedures for the manual sampling and analysis methods consisted of the following procedures: field blank samples, field spiked samples, replicate samples, matrix spike and matrix spike duplicates (MS/MSD), and laboratory control sample and laboratory control sample duplicates (LCS/LCSD).

5.3.1 CARB Method 430 Data Quality

Table 5-3 shows the results of duplicate analyses for the CARB 430 method. The relative percent difference of these measurements is outside the internal QA standard of 10% used by the analytical lab for several sample sets. However, most of the samples with poor duplicate results contained formaldehyde in either unusually high or low levels. Duplicate analyses are difficult to perform on samples containing high concentrations of the pollutants of interest due to the dilutions required to analyze these samples without overloading the instrument detector. Each dilution introduces additional error to the analysis. The high relative percent difference (RPD) observed for sample GRI4-430-42 is likely related to errors introduced during dilution.

Table 5-2

FTIR QC Data Summary

Date	Time	Compound	QC Input (ppmv)	FTIR Output (ppmv)	Bias (%)
8/23/94	854	CO	99.7	113	13.3
	2136	CO	99.7	106	6.3
8/24/94	938	CO	99.7	108	8.3
	1310	CO	99.7	102	2.3
8/25/94	932	Ethylene	100.0	100.2	0.2
	1305	Ethylene	100.0	99.7	-0.3
	2003	CO	99.7	100	0.3
8/26/94	905	CO	99.7	93	-6.7
	1615	CO	99.7	96	-3.7
	1830	Ethylene	100.0	98	-2.0
		CO	99.7	81	-18.8
8/27/94	930	CO	99.7	100	0.3
	1727	CO	99.7	109	9.3
8/28/94	833	CO	99.7	107	7.3
	1745	CO	99.7	110	10.3
8/29/94	830	CO	99.7	98	-1.7
	1420	CO	99.7	97	-2.7
	1718	CO	99.7	88	-11.7
8/30/94	656	CO	99.7	97	-2.7

Table 5-3

CARB Method 430 Duplicate Analytical Results

Sample	Dilution Factor	Analyte	Dup 1 (μg)	Dup 2[a] (μg)	RPD[b] (%)
GRI4-430-04	1.0	Formaldehyde	1.2	1.2	0.0
		Acetaldehyde	0.41	0.33	22
		Butyraldehyde	0.21	ND (0.10)	71
		Propanal	0.4	0.24	50
GRI4-430-24	51.0	Formaldehyde	150	150	0.0
GRI4-430-42	100.0	Formaldehyde	330	220	40
		Acetaldehyde	14	ND (10)	33
GRI4-430-60	2.0	Formaldehyde	37	33	11
		Acetaldehyde	3.2	2.6	21
		Acrolein	0.31	0.26	18
		Butyraldehyde	0.54	0.43	23
		Propanal	0.73	0.53	32
GRI4-430-80	2.0	Formaldehyde	39	36	8.0
		Acetaldehyde	1.7	1.7	0.0
		Acrolein	0.36	ND (0.20)	57
		Butyraldehyde	0.44	0.57	26
		Propanal	0.94	0.68	32
GRI4-430-98	11.0	Formaldehyde	200	220	9.5
		Acetaldehyde	3.7	3.9	5.3
GRI4-430-118	100.0	Formaldehyde	190	210	10
GRI4-430-136	1.0	Formaldehyde	2.3	2.0	14
		Propanal	0.18	0.15	18
GRI4-430-156	1.0	Formaldehyde	2.6	2.9	11
		Acetaldehyde	0.91	0.98	7.4
		Acrolein	0.14	ND (0.10)	33
		Butyraldehyde	0.47	0.49	4.2
		Propanal	0.46	0.51	10

[a]ND = non-detect, value in parentheses represents the detection limit.
[b]RPD = relative percent difference.

Conversely, it is also difficult to obtain good agreement between samples containing very low levels (<1 μg) of aldehydes due to the problems inherent in measuring the difference between two small values. The high RPD calculated for almost all of the heavier aldehydes (e.g., acrolein, butyaldehyde, and propanol) can be attributed to this difficulty.

Four different types of spike recovery data are collected for CARB Method 430 QA purposes:

- laboratory matrix spikes;
- field spikes;
- laboratory trip spikes; and
- laboratory spikes.

The field spikes are performed on-site by the sampling team. A known quantity of formaldehyde is added to a set of impingers which has not been exposed to flue gas, then the spiked impinger solutions are recovered following the standard sample recovery procedure. This approach provides a check of sample recovery quality.

A laboratory matrix spike adds a known quantity of spiking solution (generally 3 μg) to a sample which was already recovered in the field. The spiked material reacts with any excess DNPH in the samples. This evaluates the presence of interfering constituents in the recovered spike solution. Laboratory trip spikes are samples prepared in the lab, shipped to the test site with the DNPH solutions, recovered on-site, and shipped back to the lab. These spikes can identify possible interference due to sample handling. The laboratory spike is performed in the lab to check the accuracy of analytical equipment.

Table 5-4 summarizes the spike recovery data. The laboratory matrix spike recoveries were extremely poor. The spike recoveries were within the acceptable range of 70-130% for all three pollutants (e.g., formaldehyde, acetaldehyde, and acrolein) for only one sample. The remaining seven spiked samples each had at least one compound recovered outside of the quality control limits. As with the duplicate analyses, the poor spike recoveries can be attributed to the high formaldehyde concentrations present in

Table 5-4

CARB 430 Spike Recovery Data (%)

Sample ID Number	Dilution Factor	Formaldehyde	Acetaldehyde	Acrolein
Laboratory Matrix Spike Recoveries				
GRI4-430-10	1.0	101	102	111
GRI4-430-30	100	NR	NR	NR
GRI4-430-48	100	9Q	NR	NR
GRI4-430-66	5.0	NR	NR	NR
GRI4-430-86	5.0	25Q	19Q	16Q
GRI4-430-104	100	NR	NR	NR
GRI4-430-124	100	NR	NR	NR
GRI4-430-142	1.0	81	57Q	105
Radian Field Spike Recoveries				
GRI4-430-114	1.0	87	77	NS
GRI4-430-152	1.0	89	82	NS
Laboratory (Trip) Spike Recoveries				
GRI4-430-20	1.0	85	NS	NS
GRI4-430-76	1.0	90	NS	NS
Laboratory (lab) Spike Recoveries				
9408285-08A	1.0	90	90	102
9408286-10A	1.0	90	91	103
9408287-08A	1.0	90	91	103
9408288-10A	1.0	93	87	67Q
9408289-08A	1.0	93	87	99
9408290-10A	1.0	84	48Q	87
9408291-08A	1.0	74	62Q	83
9408292-10A	1.0	74	62Q	83
9408293-04A	1.0	74	62Q	83

NR = No recovery due to matrix effects.

NA = Not analyzed.

NS = Not spiked.

Q = Exceeds quality control limits of 70 to 130%.

many of these samples. This has the impact of introducing errors due to dilution and increases the likelihood that the small spiked amount (~3 μg) can be lost in the noise of a signal for a high concentration sample.

The results of the field spikes, trip spikes, and most of the lab spikes were acceptable. The acetaldehyde lab spike recoveries were outside the acceptable range for the last four samples. Based on the similarity in recoveries for these samples, it is likely that the lab was using a poorly-made standard these days.

5.3.2 CARB Method 429 Data Quality

Quality assurance data for the CARB Method 429 runs are shown in Table 5-5. Isokinetic sampling and leak checks were all within acceptable limits (± 10% isokinetics, <0.02 acfm leak rate). Analysis of the field blank sample yielded background levels of target compounds that were all below the method detection limit. This indicates good resolution for detected compounds. The results were not blank corrected. The laboratory control sample recoveries met the 50 to 150% acceptance criteria. The duplicate analyses were also within the acceptable range with a relative percent difference calculated under 15% for all compounds. These results are presented in Table 5-6. Table 5-7 presents the isotopic recovery results. Recoveries ranged from 52 to 142%, which is also within the acceptance criteria of 50 to 150 percent.

5.3.3 Method 201A Data Quality

Table 5-8 summarizes the sampling QA data for the four particulate matter runs. All runs were sampled within the 80-120% isokinetic range specified by EPA Method 201A, except for Engine 9 which was at 120.7 percent. The calculated aerodynamic diameter cut points were slightly above 11 microns for all but one test, which means that the PM_{10} emission rates may be biased high.

5.3.4 Method 18 Data Quality

The quality control procedures specified in Method 18 were followed. The retention time of the analytes of interest were determined using certified calibration gases, and calibration curves were developed for use in quantitation. Table 5-9 summarizes the Method 18 GC calibration data.

Table 5-5

CARB Method 429 Leak Check Results

Date	Engine	Initial Leak Rate (acfm)	Final Leak Rate (acfm)
8/23/94	Waukesha	0.002 @ 15" Hg	0.002 11" Hg
8/24/94	Field Blank	0.014 @ 15" Hg	NR
8/26/94	4	0.008 @ 15" Hg	0.008 @ 10" Hg
8/27/94	8	0.004 @ 15" Hg	NR
8/28/94	9	0.001 @ 15" Hg	NR
8/29/94	9	0.003 @ 15" Hg	0.003 @ 7" Hg

NR = Not recorded.

Table 5-6

CARB Method 429 Laboratory Control Sample Results

Compound	LCS1 (%R)[a]	LCS2 (%R)[a]	RPD[b] (%)
Naphthalene	82	68	18.7
2-Methylnaphthalene	85	80	6.1
Acenaphthylene	82	76	7.6
Acenaphthene	74	85	13.8
Fluorene	89	90	1.1
Phenanthrene	84	89	5.8
Anthracene	80	85	6.1
Fluoranthene	84	82	2.4
Pyrene	84	78	7.4
Benz(a)anthracene	80	80	0.0
Chrysene	89	78	13.2
Benzo(b)fluoranthene	92	80	14.0
Benzo(k)fluoranthene	77	78	1.3
Benzo(e)pyrene	77	76	1.3
Benzo(a)pyrene	84	84	0.0
Perylene	77	76	1.3
Indeno(1,2,3-c,d)pyrene	75	80	6.5
Dibenz(a,h)anthracene	73	79	7.9
Benzo(g,h,i)perylene	85	81	4.8

[a]%R = percent recovery.

[b]RPD = relative percent difference.

Table 5-7

CARB Method 429 Isotopic Recovery Results

Internal Standard	Percent Recovered							
	Method Blank	LCS1	LCS2	GRI4-429-FB	GRI4-429-R1	GRI4-429-R2	GRI4-429-R3	GRI4-429-R4
d_8-Naphthalene	64	68	68	68	61	63	63	69
d_8-Acenaphthylene	81	81	84	82	91	83	52	94
d_{10}-Acenaphthene	90	88	88	92	94	88	65	96
d_{10}-Fluorene	104	96	106	102	108	91	59	93
d_{10}-Phenanthrene	126	112	129	119	142	88	65	102
d_{10}-Fluoranthene	88	83	87	82	77	82	90	85
d_{12}-Benz(a)anthracene	118	109	107	116	133	113	96	94
d_{12}-Chrysene	110	96	106	105	123	106	91	84
d_{12}-Benzo(b)fluoranthene	106	97	100	107	82	72	72	79
d_{12}-Benzo(k)fluoranthene	99	104	101	102	89	61	67	74
d_{12}-Benzo(a)pyrene	96	99	92	98	90	68	59	80
d_{12}-Indeno(1,2,3-c,d)pyrene	109	112	99	107	115	89	109	84
d_{12}-Benzo(g,h,i)perylene	98	92	89	89	86	99	124	82
d_{14}-Dibenz(a,h)anthracene	105	110	99	107	114	100	123	91
d_{10}-Anthracene	104	91	106	98	124	78	65	89
d_{12}-Benzo(e)pyrene	NA	NA	NA	140	116	106	142	114
d_{14}-Terphenyl	NA	NA	NA	115	93	99	80	93

NA = not analyzed.

Table 5-8

Method 201A Isokinetic Sampling and Leak Check Results

Date	Run Time	Engine	Percent Isokinetic	Initial Leak Rate (cfm)	Cut Point (microns)
8/23/94	1900 - 2230	Waukesha	97.9	0.003 @ 15" Hg	10.6
8/26/94	1613 - 1957	4	118.8	0.008 @ 15" Hg	11.0
8/27/94	1634 - 2044	8	103.4	0.002 @ 15" Hg	11.1
8/29/94	1352 - 1722	9	120.7	0.003 @ 15" Hg	11.5

Table 5-9

GC Calibration Summary

Compound	Concentration (ppm)	No. of Injections	Area Response		Height Response	
			Average	% RSD	Average	% RSD
Methane	0	8	1,526,522	109	326,528	111
	16.3	2	1,571,324	50	298,802	43
	100	5	13,218,151	15	2,401,068	5
	Linearity (R Squared)		0.9779		0.9733	
Ethane	0	8	351,253	56	76,719	58
	16.3	2	2,312,015	80	450,510	80
	100	5	25,864,061	17	4,576,923	7
	Linearity (R Squared)		0.9931		0.994	
Propane	0	8	399,407	65	62,972	71
	16.3	2	3,317,766	85	524,158	85
	100	5	39,230,291	19	5,446,312	11
	Linearity (R Squared)		0.9928		0.9944	
Butane	0	8	376,605	116	43,505	133
	16.3	2	19,632,154	99	1,167,318	95
	100	5	55,674,363	16	6,447,455	15
	Linearity (R Squared)		0.9615		0.9998	
Pentane	0	8	724,594	81	75,065	97
	16.4	2	5,100,622	93	633,145	93
	100	5	53,328,173	50	5,564,386	50
	Linearity (R Squared)		0.9939		0.9963	
Hexane	0	8	5,769,025	92	200,099	102
	16.9	2	8,572,998	94	747,921	93
	100	5	82,711,139	54	6,401,215	50
	Linearity (R Squared)		0.9841		0.9938	
Heptane	14.0	1	22,838,192	--	1,014,833	--

Campaign 6
Detailed QA/QC Summary

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The goal of the quality assurance/quality control (QA/QC) procedures is to ensure the collection of representative samples, the control of data quality during sample analysis, and the use of valid data handling procedures to provide a link between the analytical results and the physical conditions they represent. This section describes the QA/QC procedures used in the field and laboratory. All raw QA/QC data are reported in the appendices.

5.1 Process Data

Where available, process data were recorded at 15-minute intervals throughout each test period. At the end of each day, a copy of the process data collected was reviewed by the Radian field engineer. Each engine was inspected by the engine consultant prior to testing to evaluate the balance condition and identify any maintenance issues which had the potential to bias test results. Some balancing was required for every engine, and a few engines required minor maintenance. Engine analysts from the host site performed all horsepower and balance measurements.

5.2 Continuous Emission Monitors

Quality assurance procedures for the CEM systems were implemented according to the reference methods. These specifications included requirements to determine calibration drift, accuracy, and precision of the instruments. The primary method of measuring these parameters was daily analysis of control standards.

5.2.1 CEM Calibration Checks

Analyzer calibration was performed at least once each test day. Analyzer response for O_2, NO_x, CO, THC, and CO_2 was set using zero and high-level calibration gases introduced through the entire measurement system. Subsequent responses to mid-level QC gases are presented in Table 5-1.

Table 5-1

CEMS QC Data Summary

Date	Analyzer	Analyzer Range	QC Input	Units	Average Bias (%)	Response RSD[a] (%)	Calibration Drift Zero (%)	Calibration Drift Span (%)
11-4-94	O_2	25	14.01	%	0.51	0.15	-0.570	-0.296
	CO_2	20	10.01	%	1.15	0.35	0.233	-0.245
	CO	500	90.7	ppmv	-0.13	1.51	-1.189	0.526
	NO_x	1000	509	ppmv	1.59	1.48	-0.126	1.795
11-5-94	O_2	25	14.01	%	0.52	0.40	-0.063	-1.332
	CO_2	20	10.01	%	0.58	0.44	0.370	-0.126
	CO	500	90.7	ppmv	-0.02	0.96	0.473	0.357
	NO_x	1000 2500	509 890	ppmv	-0.04 2.29	1.65	0.118	-1.544
	THC	1000 2500	917 1402	ppmv	1.95 1.50	0.00	2.876	2.413
11-07-94	O_2	25	14.01	%	0.58	0.11	-0.424	-1.848
	CO_2	20	10.01	%	1.40	0.10	0.494	-0.021
	CO	100	51.2	ppmv	0.74	0.78	0.129	-0.150
	NO_x	250	77.5	ppmv	2.49	0.99	-0.033	0.227
	THC	100	92.9	ppmv	-0.17	0.44	-0.103	-0.091
11-08-94	O_2	25	14.01	%	-0.01	0.19	-0.125	0.360
	CO_2	20	10.01	%	0.93	0.30	0.339	2.716
	CO	100	51.2	ppmv	1.11	0.26	-0.041	0.159
	NO_x	250	77.5	ppmv	1.89	1.42	0.063	-0.725
	THC	100	92.9	ppmv	-1.57	1.41	0.001	-0.154
11-10-94	O_2	25	14.01	%	0.08	0.23	-0.108	-0.243
	CO_2	20	10.01	%	-0.12	0.81	0.073	-4.001
	CO	100	51.2	ppmv	0.35	2.29	-0.106	0.236
	NO_x	1000	509	ppmv	0.75	0.33	-0.017	0.655
	THC	2500	1402	ppmv	-0.10	0.44	0.029	-0.912
11-11-94	O_2	25	14.01	%	0.00	0.17	-0.063	-1.332
	CO_2	20	10.01	%	0.23	0.41	-0.255	-0.604
	CO	100	51.2	ppmv	0.38	1.92	0.166	-0.008
	NO_x	1000	509	ppmv	0.98	0.42	-0.106	-0.441
	THC	2500	1402	ppmv	0.05	0.86	0.075	-3.769

Table 5-1

(Continued)

Date	Analyzer	Analyzer Range	QC Input	Units	Average Bias (%)	Response RSD[a] (%)	Calibration Drift Zero (%)	Calibration Drift Span (%)
11-12-94	O_2	25	14.01	%	0.23	0.44	-0.094	-0.627
	CO_2	20	10.01	%	0.22	0.50	0.379	-2.963
	CO	500	51.2 90.7	ppmv	1.04 -0.24	0.29	0.082	0.328
	NO_x	1000	509	ppmv	1.13	0.51	0.008	0.824
	THC	2500	1402	ppmv	-0.02	0.28	0.814	-1.811
11/14/94	O_2	25	14.01	%	0.51	0.50	0.577	0.906
	CO_2	20	10.01	%	0.80	0.58	0.575	1.365
	CO	500	90.7	ppmv	-0.23	0.82	0.157	-0.166
	NO_x	1000	509	ppmv	0.47	0.68	0.494	-1.394
	THC	2500	1402	ppmv	1.27	0.80	-0.146	4.046
11/15/94	O_2	25	14.01	%	0.40	0.50	0.109	-0.045
	CO_2	20	10.01	%	0.50	0.105	-0.101	-0.256
	CO	500	90.7	ppmv	-0.78	1.051	0.193	0.021
	NO_x	1000	509	ppmv	1.12	0.41	0.216	-1.565
	THC	2500	1402	ppmv	0.58	1.04	-0.222	-3.716

[a]RSD = relative standard deviation.

5.2.2 CEM Drift Checks

Directly after the completion of monitoring each day, instrument specific zero and high-level QC gases were introduced through the entire measurement system and measured by the corresponding instrumentation to evaluate measurement drift. The percent drift of each instrument was determined by calculating the percent difference, relative to span, between the pre-sampling and post-sampling measured values for the QC standards. Calculated calibration drift for all analyzers was within 10 percent, as specified in the test plan. For all but 7 of 44 span drift checks and 1 of 44 zero drift checks, the calculated drift was less than 2 percent. Table 5-1 summarizes the drift calculations for the criteria pollutant CEMs.

5.2.3 Accuracy and Precision

Immediately after completion of instrument calibration, an instrument specific QC standard at the approximate concentration expected in the source gas was introduced through the entire CEM system and measured by the corresponding instrumentation. The percent difference between the measured concentration of the QC standard and the known concentration for each species was calculated to quantify measurement bias (accuracy). For O_2, CO_2, CO, and NO_x, the percent difference is calculated relative to instrument span. For THC, the percent difference is calculated relative to QC input. This procedure was repeated periodically throughout each test day to calculate an average bias for each species measurement.

The relative standard deviation (RSD) was calculated for the multiple QC checks to provide an indication of the precision (repeatability) of the species measurements. The RSD is calculated by taking the ratio of the response standard deviation to the average of response values.

Table 5-1 summarizes the measurement bias and relative standard deviation for each of the criteria pollutants on each test day. As shown in the table, all measured biases were within the specified range of ±10 percent, with only 2 of 47 bias measurements greater than 2 percent. All RSDs were within the specified range of ±5 percent, with only 1 of 44 RSDs greater than 2 percent.

5.2.4 FTIR Measurements

The FTIR instrument does not require introduction of a span gas for each species measured. Quantitation is based on reference spectra representing each of the species measured.

Daily analysis of control standards was used to determine the bias of FTIR measurements. Table 5-2 presents the results of FTIR QC activities. All biases were within the specified 10 percent range given in the test plan. Injections of halocarbon 22 were used to calibrate the instrument pathlength.

5.3 Manual Sampling Methods

Quality control procedures for the manual sampling and analysis methods consisted of the following procedures: replicate samples, laboratory matrix spike and matrix spike duplicates (MS/MSD), and laboratory control samples and laboratory control sample duplicates (LCS/LCSD).

5.3.1 CARB Method 430

Table 5-3 presents the results of duplicate analyses of the same sample for the CARB 430 Method. The relative percent difference of all measurements were within the 20 percent specified in the test plan, except for the propanal duplicate sample # 9411142. The relative percent difference for #941142 is greater than the specified range because the initial measurement was just above the detection level, and the second measurement recorded a non-detect.

As shown in Table 5-4, three different types of spike recovery data were collected for CARB Method 430 QC purposes:

- laboratory matrix spikes;
- laboratory trip spikes; and
- laboratory spikes.

In a laboratory matrix spike, a known quantity of spiking solution is added to a sample which was collected and recovered in the field. The spiked material reacts

Table 5-2

FTIR QC Data Summary

Date	Time	Compound	QC Input (ppmv)	FTIR Output (ppmv)	Bias (%)
11/4/94	0817-0930	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	91.2	-8.8
	1906-1923	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	91.5	-8.5
11/5/94	0820-0839	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	91.7	-8.3
	1844-1901	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	91.4	-8.6
11/7/94	1604-1615	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	90.6	-9.4
	1903-1915	Methane	92.9	91.7	-1.3
		Formaldehyde	4.7	4.6	-1.3
		Ethylene	100	92.2	-7.8
11/8/94	0756-0811	Formaldehyde	4.7	4.6	-2.1
		Ethylene	100	92.6	-7.4
	1953-2002	Methane	92.9	96.4	3.8
		Formaldehyde	4.7	4.6	-2.1
		Ethylene	100	93.7	-6.4
11/10/94	0939-0954	Formaldehyde	4.7	4.6	-2.1
		Ethylene	100	94.1	-5.9
	1840-1852	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	91.4	-8.6
11/11/94	0806-0826	Formaldehyde	4.7	4.6	-2.1
		Ethylene	100	91.8	-8.2
	1844-1855	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	90.0	-10.0
11/12/94	0805-0823	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	90.1	-9.9
	1701-1714	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	91.9	-8.1

Table 5-2

(Continued)

Date	Time	Compound	QC Input (ppmv)	FTIR Output (ppmv)	Bias (%)
11/14/94	0813-0831	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	91.7	-8.3
	2130-2139	Formaldehyde	4.7	4.5	-4.3
		Ethylene	100	91.5	-8.5
11/15/94	0820-0736	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	91.4	-8.6
	1833-1841	Formaldehyde	4.7	4.4	-6.4
		Ethylene	100	91.2	-8.8

Table 5-3

CARB 430 Duplicate Results

Sample	Analyte	Dup 1 (μg)	Dup 2 (μg)	RPD[a] (%)
9411150	Formaldehyde	12	12	0
	Acetaldehyde	8.1	8.1	0
	Acrolein	0.53	0.54	1.9
	Butyraldehyde	2.9	3.1	6.7
	Propanal	2.1	2.1	0
9411160	Formaldehyde	180	160	11.8
	Acetaldehyde	16	14	13.3
	Acrolein	3.1	2.8	10.2
	Butyraldehyde	ND	ND	--
	Propanal	ND	ND	--
9411162	Formaldehyde	210	200	4.9
	Acetaldehyde	23	22	4.4
	Acrolein	3.9	4.0	2.5
	Butyraldehyde	2.1	2.3	9.1
	Propanal	4.9	4.6	6.3
9411163	Formaldehyde	150	150	0
	Acetaldehyde	6.0	6.0	0
	Acrolein	1.3	1.1	16.7
	Butyraldehyde	ND	ND	--
	Propanal	1.1	1.3	16.7
9411165	Formaldehyde	140	140	0
	Acetaldehyde	6.2	6.3	1.6
	Acrolein	ND	ND	--
	Butyraldehyde	ND	ND	--
	Propanal	ND	ND	--
9411142	Formaldehyde	130	120	8.0
	Acetaldehyde	6.8	6.3	7.6
	Acrolein	1.9	1.7	11.1
	Butyraldehyde	ND	ND	--
	Propanal	0.87	ND (0.5)	54.0
9411146	Formaldehyde	120	120	0
	Acetaldehyde	17	18	5.7
	Acrolein	3.2	3.3	3.1
	Butyraldehyde	2.6	3.1	17.5
	Propanal	2.7	2.8	3.6

Table 5-3

(Continued)

Sample	Analyte	Dup 1 (μg)	Dup 2 (μg)	RPD[a] (%)
9411146	Formaldehyde	0.55	0.65	16.7
	Acetaldehyde	1.0	0.94	6.0
	Acrolein	ND	ND	--
	Butyraldehyde	0.39	0.38	2.6
	Propanal	0.4	0.35	13.3

[a]Relative Percent Difference.

Table 5-4

CARB Method 430 Spike Recovery Data
(Recovery %)

Sample ID Number	Formaldehyde	Acetaldehyde	Acrolein
Laboratory Matrix Spike Recoveries			
9411146	338 Q	114	135 Q
9411148	101	102	116
9411143	250 Q	113	130
9411150	95	105	107
9411160	274 Q	120	158 Q
9411162	9.0 Q	81	128
9411164	400 Q	120	158 Q
9411166	168 Q	114	133 Q
Laboratory Trip Spike Recoveries			
9411166	82	74	NS
Laboratory Spike Recoveries			
9411142	77	110	106
9411158	88	70	103
9411164	97	92	108
9411165	87	90	91

Q = Exceeds quality control limits of 70 to 130%.
NS = Not sampled

with excess DNPH in the samples aiding in evaluating the presence of interfering constituents in the recovered spike solution. The poor recoveries on the laboratory matrix spike samples are believed to be caused by spiking a small amount of the target compounds into samples containing large quantities of the target analytes and trying to determine a difference between the spiked and unspiked samples.

Laboratory trip spikes are samples prepared in the laboratory, shipped to the test site with the DNPH solutions, recovered on-site, and shipped back to the laboratory. These spikes can identify possible interference due to sample handling. The laboratory spike is performed in the laboratory to check the accuracy of analytical equipment.

5.3.2 SW-846 Method 0010

Table 5-5 shows the surrogate recovery data for each testing period. All recoveries were in the 70 to 130 percent range specified in the test plan as the acceptable range. All isokinetic and leak check results were within acceptable limits (±10% isokinetics, <0.02 acfm leak rate), except for the isokinetic sampling rate for the Clark HBA-5 (Engine 12). The low isokinetic rate (72.5 percent) was due to an incorrectly sized sampling nozzle. The low isokinetics for this test, is not expected to have an adverse effect on semi-volatile results.

5.3.3 EPA Method 18

The quality control procedures specified in Method 18 were followed. For all linearity multipoint calibrations, the correlation coefficient was greater than 0.99, except on November 7, 8, and 10, when less than three points were used to perform the regression.

Table 5-5

SW-846 Method 0010 Surrogate Recovery Data
(Recovery %)

Surrogate	Field Blank	Clark HBA-5 (Engine 12)	Solar Taurus	CB GMVC-10 (Engine 15)	CB GMVA-10 (Engine 9)
2-Fluorobiphenyl	90	114	82	99	95
2-Fluorophenol	95	84	87	88	92
Nitrobenzene-d_5	98	110	87	104	116
Phenol-d_5	98	90	90	98	100
Terphenyl-d_{14}	106	124	100	118	107
2,4,6-Tribromophenol	91	102	89	105	87

Appendix D

Detailed Data Summary

DETAILED DATA SUMMARY

Appendix D presents the data used in the engine report to 1) study the effects of operating conditions on formaldehyde levels and 2) generate emission factors for the targeted compounds. The tables are grouped by engine family and emission control device. In each group, process and emission data for each test conducted under the GRI-Air Toxics Phase II campaigns are given. The emission data presented for the targeted compounds represent measurements taken by the chosen method for each compound, as discussed in Section 6. Appendix E presents all of the data collected during the GRI-Air Toxics Phase II testing campaigns.

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2-Stroke Lean-Burn

GRI Campaign 4 - Process Conditions
Engine 1
C-B GMVA-10

Test Date	8/25/94
Test Time	0952-1020
Load Condition	Intermediate
Sampling Location	Exhaust
Test Period	6
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1350
Rated RPM	300
Year Installed	1956
Pollution Control	None
Engine Operating Conditions	
Brake horsepower (BHP)	1159
Engine Speed (rpm)	296
Load (%)	86
Fuel Flow (scf/min) (a)	--
Heat Input (MMBtu/hr)	--
Heat Rate (Btu/BHP-hr, HHV)	--
Heat Rate (Btu/BHP-hr, LHV)	--
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	NM
Vol. Flow (dscfm) - M19, Fd	--
Stack Gas Temperature (°F)	517
Moisture (%V)	7.3
O2 (%V, dry)	14.6
CO2 (%V, dry)	3.4
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	84
Relative Humidity (%)	34.7
Abs. Humidity (lb H2O/1000 lb dry air)	8.9
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	93
Ethane (%V, dry)	2.9
Propane (%V, dry)	0.45
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8470

NM - Not measured.

a Fuel flow measurements from this engine are considered suspect. Due to the computational procedures employed, these inaccuracies affect heat input, heat rate, exhaust flowrate, emission flowrates, and emission factors; therefore, these these parameters are not calculated.

Emission Summary
GRI Campaign 4
C–B GMVA–10

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP–hr)
86% Load	**Aldehydes**				
Test Period 6	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.3	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	7.3	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3–Trimethylbenzene	NM	--	--	--
	1,2,4–Trimethylbenzene	NM	--	--	--
	1,3–Butadiene (HAP)	NM	--	--	--
	1,3,5–Trimethylbenzene	NM	--	--	--
	2,2,4–Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n–Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	NM	--	--	--
	n–Nonane	NM	--	--	--
	n–Octane	NM	--	--	--
	n–Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	73.9	--	--	--
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	132	--	--	--
	THC	1364	--	--	--

ND=Non–detect

NM=Not Measured

Note: Emission rates are not presented as no exhaust flowrate was calculated for this engine.

Emission Summary
GRI Campaign 4
C-B GMVC-10

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
86% Load	Semi-Volatile Organics *				
Test Period 6	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6A CEM Results
Engine 10
Clark BA-5

Test Date	**11/04/94**
Test Time	**1000-1224**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**1**
Unit Description	
Engine Type	2-Stroke, PS
Rated BHP	911
Rated RPM	300
Year Installed	1948
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	851
Engine Speed (rpm)	299
Load (%)	94
Fuel Flow (scf/min)	161
Heat Input (MMBtu/hr) (a)	9.8
Heat Rate (Btu/BHP-hr, HHV)	11627
Heat Rate (Btu/BHP-hr, LHV)	10529
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7163
Vol. Flow (dscfm) - M19, Fd (b)	4272
Stack Gas Temperature (°F)	458
Moisture (%V)	10.4
O2 (%V, dry)	14.2
CO2 (%V, dry)	4.3
Ambient Conditions	
Barometric Pressure (in. Hg)	26.4
Ambient Temperature (°F)	62
Relative Humidity (%)	62.7
Abs. Humidity (lb H2O/1000 lb dry air)	8.2
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.76
Propane (%V, dry)	0.42
n-Hexane (ppmvd)	49
Benzene (ppmvd)	7.8
Toluene (ppmvd)	9.7
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.46
Fd Factor (dscf/MMBtu)	8427

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
94% Load	**Aldehydes**				
Test Period 1	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	16.4	3.7E-01	1.6E+00	2.0E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Timethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	7.7	2.0E-01	8.0E-01	9.0E-02
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	522	6.3E+00	2.8E+01	3.4E+00
	Methanol (HAP)	1.22	3.0E-02	1.3E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	76.0	1.6	7.0	0.86
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	805	28.0	122	14.9
	THC	NM	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
94% Load	Semi-Volatile Organics *				
Test Period 1	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6A CEM Results
Engine 10
Clark BA-5

Test Date	**11/05/94**
Test Time	**0936-1209**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**2**
Unit Description	
Engine Type	2-Stroke, PS
Rated BHP	911
Rated RPM	300
Year Installed	1948
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	910
Engine Speed (rpm)	299
Load (%)	100
Fuel Flow (scf/min)	174
Heat Input (MMBtu/hr) (a)	10.5
Heat Rate (Btu/BHP-hr, HHV)	11737
Heat Rate (Btu/BHP-hr, LHV)	10627
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7493
Vol. Flow (dscfm) - M19, Fd (b)	4679
Stack Gas Temperature (°F)	455
Moisture (%V)	8.0
O2 (%V, dry)	14.3
CO2 (%V, dry)	4.4
Ambient Conditions	
Barometric Pressure (in. Hg)	29.3
Ambient Temperature (°F)	62
Relative Humidity (%)	29.3
Abs. Humidity (lb H2O/1000 lb dry air)	3.5
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	2.76
Propane (%V, dry)	0.47
n-Hexane (ppmvd)	49
Benzene (ppmvd)	7.8
Toluene (ppmvd)	9.7
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.46
Fd Factor (dscf/MMBtu)	8454

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	**Aldehydes**				
Test Period 2	Acetaldehyde (HAP)	1.96	7.0E-02	3.1E-01	4.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.26	1.5E-02	6.7E-02	7.6E-03
	Formaldehyde (HAP)	16.0	3.9E-01	1.7E+00	2.0E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	ND	--	--	--
	1,2,4-Trimethylbenzene	0.006	6.1E-04	2.7E-03	3.1E-04
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	0.03	2.5E-03	1.1E-02	1.2E-03
	Acetylene	ND	--	--	--
	Benzene (HAP)	0.19	1.2E-02	5.2E-02	6.0E-03
	Butane	0.48	2.3E-02	1.0E-01	1.1E-02
	Cyclohexane	0.03	1.8E-03	8.1E-03	9.2E-04
	Cyclopentane	0.007	4.1E-04	1.8E-03	2.0E-04
	Ethane	13.1	3.2E-01	1.4E+00	1.6E-01
	Ethyl Benzene (HAP)	0.005	4.6E-04	2.0E-03	2.3E-04
	Ethylene	ND	--	--	--
	n-Hexane (HAP)	0.04	3.1E-03	1.4E-02	1.6E-03
	Isobutane	0.42	2.0E-02	8.7E-02	9.9E-03
	Methane	661	8.6E+00	3.8E+01	4.3E+00
	Methanol (HAP)	1.44	4.0E-02	1.6E-01	2.0E-02
	Methylcyclohexane	0.02	1.4E-03	6.3E-03	7.1E-04
	n-Nonane	ND	--	--	--
	n-Octane	0.003	2.5E-04	1.1E-03	1.2E-04
	n-Pentane	0.13	7.5E-03	3.3E-02	3.7E-03
	Propane	4.2	1.5E-01	6.6E-01	7.5E-02
	Propylene	ND	--	--	--
	Styrene (HAP)	0.004	3.8E-04	1.7E-03	1.9E-04
	Toluene (HAP)	0.07	5.4E-03	2.4E-02	2.7E-03
	Xylene (m,p,o) (HAP)	0.01	7.7E-04	3.4E-03	3.9E-04
	"Criteria" Pollutants				
	CO	82.8	1.9	8.3	0.9
	NMHC	520	3.7	16.1	1.8
	NMEHC	504	3.3	14.6	1.7
	NOx	1195	44.8	196	22.3
	THC	943	12.3	53.8	6.1

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	Semi-Volatile Organics *				
Test Period 2	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6A CEM Results
Engine 10
Clark BA-5

Test Date	**11/04/94**
Test Time	**1448-1603**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**3**
Unit Description	
Engine Type	2-Stroke, PS
Rated BHP	911
Rated RPM	300
Year Installed	1948
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	725
Engine Speed (rpm)	301
Load (%)	80
Fuel Flow (scf/min)	147
Heat Input (MMBtu/hr) (a)	8.9
Heat Rate (Btu/BHP-hr, HHV)	12468
Heat Rate (Btu/BHP-hr, LHV)	11291
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7313
Vol. Flow (dscfm) - M19, Fd (b)	4356
Stack Gas Temperature (°F)	436
Moisture (%V)	8.8
O2 (%V, dry)	14.9
CO2 (%V, dry)	3.9
Ambient Conditions	
Barometric Pressure (in. Hg)	26.4
Ambient Temperature (°F)	51
Relative Humidity (%)	93.0
Abs. Humidity (lb H2O/1000 lb dry air)	8.1
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.76
Propane (%V, dry)	0.42
n-Hexane (ppmvd)	49
Benzene (ppmvd)	7.8
Toluene (ppmvd)	9.7
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.46
Fd Factor (dscf/MMBtu)	8427

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
80% Load	**Aldehydes**				
Test Period 3	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.03	1.5E-03	6.4E-03	9.2E-04
	Formaldehyde (HAP)	22.6	4.7E-01	2.1E+00	2.9E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	17.0	3.5E-01	1.6E+00	2.2E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	819	9.1E+00	4.0E+01	5.7E+00
	Methanol (HAP)	1.32	3.0E-02	1.3E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	93.9	1.81	7.94	1.13
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	367	11.6	50.9	7.28
	THC	NM	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6A
Clark BA-5 (Engine 10)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
80% Load	Semi-Volatile Organics *				
Test Period 3	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6A CEM Results
Engine 12
Clark HBA-5

Test Date	**11/04/94**
Test Time	**1702-1832**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**4**
Unit Description	
Engine Type	2-Stroke, PS
Rated BHP	1000
Rated RPM	300
Year Installed	1951
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	741
Engine Speed (rpm)	297
Load (%)	75
Fuel Flow (scf/min)	140
Heat Input (MMBtu/hr) (a)	8.5
Heat Rate (Btu/BHP-hr, HHV)	11612
Heat Rate (Btu/BHP-hr, LHV)	10516
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4502
Vol. Flow (dscfm) - M19, Fd (b)	4759
Stack Gas Temperature (°F)	540
Moisture (%V)	6.8
O2 (%V, dry)	15.7
CO2 (%V, dry)	3.3
Ambient Conditions	
Barometric Pressure (in. Hg)	26.4
Ambient Temperature (°F)	51
Relative Humidity (%)	92.3
Abs. Humidity (lb H2O/1000 lb dry air)	8.0
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.76
Propane (%V, dry)	0.42
n-Hexane (ppmvd)	49
Benzene (ppmvd)	7.8
Toluene (ppmvd)	9.7
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.46
Fd Factor (dscf/MMBtu)	8427

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6A
Clark HBA-5 (Engine 12)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
75% Load	**Aldehydes**				
Test Period 4	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	2.55	9.0E-02	4.1E-01	6.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	37.7	7.4E-01	3.2E+00	4.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	40.6	8.0E-01	3.5E+00	4.9E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1696	1.8E+01	7.8E+01	1.1E+01
	Methanol (HAP)	1.74	4.0E-02	1.6E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	258	4.7	20.7	2.9
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	559	16.9	74.0	10.3
	THC	NM	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6A
Clark HBA-5 (Engine 12)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
75% Load	Semi-Volatile Organics *				
Test Period 4	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6A CEM Results
Engine 12
Clark HBA-5

Test Date	**11/05/94**
Test Time	**1345-1802**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**5**
Unit Description	
Engine Type	2-Stroke, PS
Rated BHP	1000
Rated RPM	300
Year Installed	1951
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	839
Engine Speed (rpm)	301
Load (%)	84
Fuel Flow (scf/min)	150
Heat Input (MMBtu/hr) (a)	9.0
Heat Rate (Btu/BHP-hr, HHV)	10947
Heat Rate (Btu/BHP-hr, LHV)	9912
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4473
Vol. Flow (dscfm) - M19, Fd (b)	4617
Stack Gas Temperature (°F)	592
Moisture (%V)	6.9
O2 (%V, dry)	15.1
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	71
Relative Humidity (%)	23.2
Abs. Humidity (lb H2O/1000 lb dry air)	4.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	2.76
Propane (%V, dry)	0.47
n-Hexane (ppmvd)	49
Benzene (ppmvd)	7.8
Toluene (ppmvd)	9.7
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.46
Fd Factor (dscf/MMBtu)	8454

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6A
Clark HBA-5 (Engine 12)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
84% Load	**Aldehydes**				
Test Period 5	Acetaldehyde (HAP)	3.39	1.1E-01	4.6E-01	6.0E-02
	Acrolein (HAP)	2.6	1.0E-01	4.5E-01	6.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	27	5.7E-01	2.5E+00	3.1E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	23.4	5.0E-01	2.2E+00	2.7E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1050	1.2E+01	5.2E+01	6.4E+00
	Methanol (HAP)	1.47	3.0E-02	1.5E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	202	4.0	17.4	2.2
	NMHC	407	4.60	20.1	2.50
	NMEHC	360.2	4.10	17.8	2.20
	NOx	1053	34.0	149	18.4
	THC	1457	16.4	71.8	8.9

ND=Non-detect

NM=Not Measured

12/01/95 C6E12T5.WK4

Emission Summary
GRI Campaign 6 - Station 6A
Clark HBA-5 (Engine 12)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
84% Load	Semi-Volatile Organics *				
Test Period 5	Acenaphthene	0.05	3.2E-05	1.4E-04	1.7E-05
	Acenaphthylene	0.12	7.4E-05	3.3E-04	4.0E-05
	Anthracene	0.03	1.8E-05	7.8E-05	9.6E-06
	Benz(a)anthracene	0.01	8.0E-06	3.5E-05	4.3E-06
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	0.09	5.5E-05	2.4E-04	3.0E-05
	Chysene	0.02	1.4E-05	6.2E-05	7.6E-06
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.01	6.0E-06	2.6E-05	3.2E-06
	Fluorene	0.07	4.3E-05	1.9E-04	2.4E-05
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	0.78	4.7E-04	2.1E-03	2.6E-04
	Naphthalene	1.69	1.0E-03	4.5E-03	5.6E-04
	Perylene	ND	--	--	--
	Phenanthrene	0.14	8.6E-05	3.8E-04	4.6E-05
	Phenol	1.07	6.5E-04	2.9E-03	3.5E-04
	Pyrene	0.02	1.1E-05	4.9E-05	6.1E-06

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 9
C-B GMVA-10

Test Date	**11/11/94**
Test Time	**1600-1800**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**12**
Unit Description	
Engine Type	2-Stroke, BS
Rated BHP	1235
Rated RPM	300
Year Installed	1954
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1078
Engine Speed (rpm)	299
Load (%)	88
Fuel Flow (scf/min)	168
Heat Input (MMBtu/hr) (a)	10.1
Heat Rate (Btu/BHP-hr, HHV)	9511
Heat Rate (Btu/BHP-hr, LHV)	8652
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4991
Vol. Flow (dscfm) - M19, Fd (b)	5079
Stack Gas Temperature (°F)	576
Moisture (%V)	7.2
O2 (%V, dry)	15.1
CO2 (%V, dry)	3.6
Ambient Conditions	
Barometric Pressure (in. Hg)	26.6
Ambient Temperature (°F)	65
Relative Humidity (%)	45.8
Abs. Humidity (lb H2O/1000 lb dry air)	6.6
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period 12	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.01	6.8E-04	3.0E-03	2.9E-04
	Formaldehyde (HAP)	19.1	4.4E-01	2.0E+00	1.9E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	51.6	1.2E+00	5.3E+00	5.1E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	2033	2.5E+01	1.1E+02	1.1E+01
	Methanol (HAP)	0.68	2.0E-02	7.0E-02	7.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	69.9	1.5	6.7	0.64
	NMHC	823	10.3	45.2	4.3
	NMEHC	720	9.0	39.6	3.8
	NOx	302	10.9	47.7	4.6
	THC	2856	35.8	157	15.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	Semi-Volatile Organics *				
Test Period 12	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 9
C-B GMVA-10

Test Date	**11/12/94**
Test Time	**1000-1405**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**13**
Unit Description	
Engine Type	2-Stroke, BS
Rated BHP	1235
Rated RPM	300
Year Installed	1954
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1232
Engine Speed (rpm)	300
Load (%)	100
Fuel Flow (scf/min)	174
Heat Input (MMBtu/hr) (a)	10.5
Heat Rate (Btu/BHP-hr, HHV)	8631
Heat Rate (Btu/BHP-hr, LHV)	7851
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4715
Vol. Flow (dscfm) - M19, Fd (b)	4845
Stack Gas Temperature (°F)	586
Moisture (%V)	8.3
O2 (%V, dry)	14.6
CO2 (%V, dry)	3.9
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	57
Relative Humidity (%)	85.6
Abs. Humidity (lb H2O/1000 lb dry air)	9.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	**Aldehydes**				
Test Period 13	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	16.7	4.0E-01	1.8E+00	1.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	0.004	4.0E-04	1.7E-03	1.5E-04
	1,2,4-Trimethylbenzene	0.02	1.8E-03	7.7E-03	6.5E-04
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	0.06	5.3E-03	2.3E-02	2.0E-03
	Acetylene	ND	--	--	--
	Benzene (HAP)	0.07	4.4E-03	1.9E-02	1.6E-03
	Butane	0.96	4.5E-02	2.0E-01	1.6E-02
	Cyclohexane	0.04	2.7E-03	1.2E-02	1.0E-03
	Cyclopentane	0.01	7.9E-04	3.5E-03	2.9E-04
	Ethane	27.2	6.6E-01	2.9E+00	2.4E-01
	Ethyl Benzene (HAP)	0.004	3.4E-04	1.5E-03	1.3E-04
	Ethylene	ND	--	--	--
	n-Hexane (HAP)	0.07	5.1E-03	2.2E-02	1.9E-03
	Isobutane	0.77	3.6E-02	1.6E-01	1.3E-02
	Methane	1110	1.4E+01	6.3E+01	5.3E+00
	Methanol (HAP)	0.86	2.0E-02	1.0E-01	8.0E-03
	Methylcyclohexane	0.03	2.7E-03	1.2E-02	9.8E-04
	n-Nonane	0.001	1.5E-04	6.4E-04	5.3E-05
	n-Octane	0.006	5.5E-04	2.4E-03	2.0E-04
	n-Pentane	0.22	1.3E-02	5.5E-02	4.6E-03
	Propane	7.81	2.8E-01	1.2E+00	1.0E-01
	Propylene	ND	--	--	--
	Styrene (HAP)	0.002	2.0E-04	8.9E-04	7.5E-05
	Toluene (HAP)	0.05	3.8E-03	1.7E-02	1.4E-03
	Xylene (m,p,o) (HAP)	0.01	1.1E-03	4.9E-03	4.1E-04
	"Criteria" Pollutants				
	CO	62.8	1.4	6.3	0.53
	NMHC	250	3.3	14.2	1.2
	NMEHC	196	2.6	11.1	0.94
	NOx	368	13.7	60.2	5.1
	THC	1360	17.7	77.3	6.5

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	**Semi-Volatile Organics** *				
Test Period 13	Acenaphthene	0.01	7.6E-06	3.3E-05	2.8E-06
	Acenaphthylene	0.02	1.6E-05	6.9E-05	5.8E-06
	Anthracene	0.004	2.5E-06	1.1E-05	9.4E-07
	Benz(a)anthracene	ND	--	--	--
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	0.03	2.2E-05	9.5E-05	8.0E-06
	Chysene	ND	--	--	--
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.004	2.5E-06	1.1E-05	9.2E-07
	Fluorene	0.005	2.9E-06	1.3E-05	1.1E-06
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	0.16	1.0E-04	4.5E-04	3.8E-05
	Naphthalene	0.3	1.9E-04	8.4E-04	7.1E-05
	Perylene	ND	--	--	--
	Phenanthrene	0.02	1.5E-05	6.7E-05	5.6E-06
	Phenol	0.31	2.0E-04	8.7E-04	7.3E-05
	Pyrene	0.005	3.4E-06	1.5E-05	1.3E-06

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 9
C-B GMVA-10

Test Date	**11/12/94**
Test Time	**1515-1645**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**14**
Unit Description	
Engine Type	2-Stroke, BS
Rated BHP	1235
Rated RPM	300
Year Installed	1954
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1234
Engine Speed (rpm)	300
Load (%)	100
Fuel Flow (scf/min)	173
Heat Input (MMBtu/hr) (a)	10.4
Heat Rate (Btu/BHP-hr, HHV)	8566
Heat Rate (Btu/BHP-hr, LHV)	7792
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4690
Vol. Flow (dscfm) - M19, Fd (b)	4756
Stack Gas Temperature (°F)	590
Moisture (%V)	8.4
O2 (%V, dry)	14.5
CO2 (%V, dry)	4.0
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	59
Relative Humidity (%)	82.9
Abs. Humidity (lb H2O/1000 lb dry air)	10.0
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	**Aldehydes**				
Test Period 14	Acetaldehyde (HAP)	ND	–	–	–
	Acrolein (HAP)	ND	–	–	–
	Butyr/Isobutyraldehyde	ND	–	–	–
	Formaldehyde (HAP)	16.6	4.0E-01	1.8E+00	1.5E-01
	Propionaldehyde (HAP)	NM	–	–	–
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	–	–	–
	1,2,4-Trimethylbenzene	NM	–	–	–
	1,3-Butadiene (HAP)	NM	–	–	–
	1,3,5-Trimethylbenzene	NM	–	–	–
	2,2,4-Trimethylpentane (HAP)	NM	–	–	–
	Acetylene	NM	–	–	–
	Benzene (HAP)	NM	–	–	–
	Butane	NM	–	–	–
	Cyclohexane	NM	–	–	–
	Cyclopentane	NM	–	–	–
	Ethane	26.1	6.3E-01	2.8E+00	2.3E-01
	Ethyl Benzene (HAP)	NM	–	–	–
	Ethylene	NM	–	–	–
	n-Hexane (HAP)	NM	–	–	–
	Isobutane	NM	–	–	–
	Methane	984	1.3E+01	5.6E+01	4.7E+00
	Methanol (HAP)	0.9	2.0E-02	1.0E-01	8.0E-03
	Methylcyclohexane	NM	–	–	–
	n-Nonane	NM	–	–	–
	n-Octane	NM	–	–	–
	n-Pentane	NM	–	–	–
	Propane	NM	–	–	–
	Propylene	NM	–	–	–
	Styrene (HAP)	NM	–	–	–
	Toluene (HAP)	NM	–	–	–
	Xylene (m,p,o) (HAP)	NM	–	–	–
	"Criteria" Pollutants				
	CO	61.6	1.4	6.1	0.51
	NMHC	327	4.2	18.5	1.6
	NMEHC	275	3.5	15.5	1.3
	NOx	358	13.3	58.2	4.9
	THC	1311	16.9	74.1	6.2

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVA-10 (Engine 9)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	Semi-Volatile Organics *				
Test Period 14	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 15
C-B GMVC-10

Test Date	**11/10/94**
Test Time	**1030-1500**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**9**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1963
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1827
Engine Speed (rpm)	300
Load (%)	102
Fuel Flow (scf/min)	266
Heat Input (MMBtu/hr) (a)	16.0
Heat Rate (Btu/BHP-hr, HHV)	8900
Heat Rate (Btu/BHP-hr, LHV)	8061
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7570
Vol. Flow (dscfm) - M19, Fd (b)	7972
Stack Gas Temperature (°F)	581
Moisture (%V)	7.0
O2 (%V, dry)	15.0
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.7
Ambient Temperature (°F)	53
Relative Humidity (%)	46.5
Abs. Humidity (lb H2O/1000 lb dry air)	4.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
102% Load	**Aldehydes**				
Test Period 9	Acetaldehyde (HAP)	1.82	1.0E-01	4.4E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	18.1	6.7E-01	3.0E+00	1.7E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	19.9	7.4E-01	3.3E+00	1.8E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	772	1.5E+01	6.7E+01	3.8E+00
	Methanol (HAP)	0.70	3.0E-02	1.2E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	71.2	2.5	10.8	0.6
	NMHC	272	5.40	23.7	1.30
	NMEHC	232	4.6	20.2	1.2
	NOx	560	31.9	140	7.9
	THC	1044	20.7	90.8	5.2

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
102% Load	Semi-Volatile Organics *				
Test Period 9	Acenaphthene	0.02	2.3E-05	1.0E-04	5.7E-06
	Acenaphthylene	0.05	4.9E-05	2.2E-04	1.2E-05
	Anthracene	0.009	9.2E-06	4.0E-05	2.3E-06
	Benz(a)anthracene	0.005	5.5E-06	2.4E-05	1.4E-06
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	0.06	6.0E-05	2.6E-04	1.5E-05
	Chysene	0.01	1.2E-05	5.2E-05	2.9E-06
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.007	7.0E-06	3.1E-05	1.7E-06
	Fluorene	ND	--	--	--
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	0.35	3.6E-04	1.6E-03	9.0E-05
	Naphthalene	0.71	7.5E-04	3.3E-03	1.9E-04
	Perylene	ND	--	--	--
	Phenanthrene	0.05	5.6E-05	2.5E-04	1.4E-05
	Phenol	0.54	5.7E-04	2.5E-03	1.4E-04
	Pyrene	0.009	9.3E-06	4.1E-05	2.3E-06

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 15
C-B GMVC-10

Test Date	**11/10/94**
Test Time	**1546-1801**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**10**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1963
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1830
Engine Speed (rpm)	300
Load (%)	102
Fuel Flow (scf/min)	266
Heat Input (MMBtu/hr) (a)	16.0
Heat Rate (Btu/BHP-hr, HHV)	8884
Heat Rate (Btu/BHP-hr, LHV)	8046
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7588
Vol. Flow (dscfm) - M19, Fd (b)	7749
Stack Gas Temperature (°F)	576
Moisture (%V)	7.0
O2 (%V, dry)	14.8
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.6
Ambient Temperature (°F)	58
Relative Humidity (%)	36.2
Abs. Humidity (lb H2O/1000 lb dry air)	4.2
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	**Aldehydes**				
Test Period 10	Acetaldehyde (HAP)	1.49	8.0E-02	3.6E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.04	3.7E-03	1.6E-02	9.3E-04
	Formaldehyde (HAP)	17.7	6.6E-01	2.9E+00	1.6E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	0.005	6.6E-04	2.9E-03	1.6E-04
	1,2,4-Trimethylbenzene	0.02	2.8E-03	1.2E-02	6.9E-04
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	0.003	3.7E-04	1.6E-03	9.0E-05
	2,2,4-Trimethylpentane (HAP)	0.08	1.2E-02	5.2E-02	3.0E-03
	Acetylene	ND	--	--	--
	Benzene (HAP)	0.15	1.4E-02	6.2E-02	3.5E-03
	Butane	1.75	1.3E-01	5.6E-01	3.2E-02
	Cyclohexane	0.07	7.6E-03	3.3E-02	1.9E-03
	Cyclopentane	0.02	2.0E-03	8.7E-03	4.9E-04
	Ethane	18.0	6.8E-01	3.0E+00	1.7E-01
	Ethyl Benzene (HAP)	0.007	8.7E-04	3.8E-03	2.2E-04
	Ethylene	ND	--	--	--
	n-Hexane (HAP)	0.14	1.5E-02	6.4E-02	3.6E-03
	Isobutane	1.33	9.6E-02	4.3E-01	2.4E-02
	Methane	673	1.4E+01	5.9E+01	3.3E+00
	Methanol (HAP)	0.67	3.0E-02	1.2E-01	7.0E-03
	Methylcyclohexane	0.05	6.5E-03	2.9E-02	1.6E-03
	n-Nonane	0.0005	7.5E-05	3.4E-04	1.9E-05
	n-Octane	0.004	5.2E-04	2.3E-03	1.3E-04
	n-Pentane	0.43	3.9E-02	1.7E-01	9.6E-03
	Propane	13.4	7.4E-01	3.2E+00	1.9E-01
	Propylene	ND	--	--	--
	Styrene (HAP)	0.01	1.9E-03	8.2E-03	4.6E-04
	Toluene (HAP)	0.09	1.0E-02	4.4E-02	2.6E-03
	Xylene (m,p,o) (HAP)	0.02	2.4E-03	1.1E-02	5.9E-04
	"Criteria" Pollutants				
	CO	69.1	2.4	10.5	0.6
	NMHC	327	6.51	28.4	1.61
	NMEHC	291	5.79	25.3	1.43
	NOx	620	35.4	155	8.8
	THC	1000	19.9	87.0	4.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	Semi-Volatile Organics *				
Test Period 10	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 15
C-B GMVC-10

Test Date	**11/11/94**
Test Time	**0930-1140**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**11**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1963
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1523
Engine Speed (rpm)	299
Load (%)	85
Fuel Flow (scf/min)	265
Heat Input (MMBtu/hr) (a)	16.0
Heat Rate (Btu/BHP-hr, HHV)	10667
Heat Rate (Btu/BHP-hr, LHV)	9661
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7363
Vol. Flow (dscfm) - M19, Fd (b)	8769
Stack Gas Temperature (°F)	552
Moisture (%V)	6.9
O2 (%V, dry)	15.5
CO2 (%V, dry)	3.4
Ambient Conditions	
Barometric Pressure (in. Hg)	26.7
Ambient Temperature (°F)	53
Relative Humidity (%)	62.6
Abs. Humidity (lb H2O/1000 lb dry air)	5.8
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	2.49
Propane (%V, dry)	0.39
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8432

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	**Aldehydes**				
Test Period 11	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.1	9.1E-03	4.0E-02	2.7E-03
	Formaldehyde (HAP)	24.5	9.2E-01	4.0E+00	2.7E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	45.6	1.7E+00	7.5E+00	5.1E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1986	4.0E+01	1.7E+02	1.2E+01
	Methanol (HAP)	0.80	3.0E-02	1.4E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	83.9	2.9	12.8	0.9
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	306	17.5	76.5	5.2
	THC	1538	30.5	134	9.1

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 15)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	Semi-Volatile Organics *				
Test Period 11	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 11
C-B GMVC-10

Test Date	**11/15/94**
Test Time	**1020-1120**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**19**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1799
Engine Speed (rpm)	300
Load (%)	100
Fuel Flow (scf/min)	236
Heat Input (MMBtu/hr) (a)	14.2
Heat Rate (Btu/BHP-hr, HHV)	8038
Heat Rate (Btu/BHP-hr, LHV)	7281
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7501
Vol. Flow (dscfm) - M19, Fd (b)	6983
Stack Gas Temperature (°F)	592
Moisture (%V)	6.7
O2 (%V, dry)	14.9
CO2 (%V, dry)	3.8
Ambient Conditions	
Barometric Pressure (in. Hg)	27.0
Ambient Temperature (°F)	50
Relative Humidity (%)	33.5
Abs. Humidity (lb H2O/1000 lb dry air)	2.8
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	94
Ethane (%V, dry)	2.55
Propane (%V, dry)	0.35
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	**Aldehydes**				
Test Period 19	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	16.2	5.4E-01	2.4E+00	1.4E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	22.6	7.5E-01	3.3E+00	1.9E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	892	1.6E+01	6.9E+01	4.0E+00
	Methanol (HAP)	0.74	3.0E-02	1.1E-01	7.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	62.7	1.9	8.5	0.49
	NMHC	120	2.10	9.30	0.54
	NMEHC	74.8	1.3	5.8	0.33
	NOx	857	43.5	191	11.0
	THC	1012	17.9	78.3	4.5

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
100% Load	Semi-Volatile Organics *				
Test Period 19	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 11
C-B GMVC-10

Test Date	**11/15/94**
Test Time	**1225-1300**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**22**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1569
Engine Speed (rpm)	301
Load (%)	87
Fuel Flow (scf/min)	217
Heat Input (MMBtu/hr) (a)	13.1
Heat Rate (Btu/BHP-hr, HHV)	8474
Heat Rate (Btu/BHP-hr, LHV)	7676
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7310
Vol. Flow (dscfm) - M19, Fd (b)	6880
Stack Gas Temperature (°F,	569
Moisture (%V)	6.5
O2 (%V, dry)	15.3
CO2 (%V, dry)	3.6
Ambient Conditions	
Barometric Pressure (in. Hg)	27.0
Ambient Temperature (°F)	55
Relative Humidity (%)	28.7
Abs. Humidity (lb H2O/1000 lb dry air)	2.9
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	94
Ethane (%V, dry)	2.55
Propane (%V, dry)	0.35
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
87% Load	**Aldehydes**				
Test Period 22	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	20.0	6.1E-01	2.7E+00	1.8E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	32.8	1.0E+00	4.4E+00	2.9E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1289	2.1E+01	9.2E+01	6.1E+00
	Methanol (HAP)	0.89	3.0E-02	1.3E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	82	2.3	10.2	0.68
	NMHC	95	1.5	6.7	0.45
	NMEHC	29	0.48	2.1	0.14
	NOx	326	15.2	66.6	4.4
	THC	1384	22.5	98.0	6.5

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
87% Load	Semi-Volatile Organics *				
Test Period 22	Acenaphthene	NM	-	-	-
	Acenaphthylene	NM	-	-	-
	Anthracene	NM	-	-	-
	Benz(a)anthracene	NM	-	-	-
	Benzo(a)pyrene	NM	-	-	-
	Benzo(e)pyrene	NM	-	-	-
	Benzo(b)fluoranthene	NM	-	-	-
	Benzo(g,h,i)perylene	NM	-	-	-
	Benzo(k)fluoroanthene	NM	-	-	-
	Biphenyl	NM	-	-	-
	Chysene	NM	-	-	-
	Dibenz(a,h)anthracene	NM	-	-	-
	Fluoranthene	NM	-	-	-
	Fluorene	NM	-	-	-
	Indeno(1,2,3-c,d)pyrene	NM	-	-	-
	2-Methylnaphthalene	NM	-	-	-
	Naphthalene	NM	-	-	-
	Perylene	NM	-	-	-
	Phenanthrene	NM	-	-	-
	Phenol	NM	-	-	-
	Pyrene	NM	-	-	-

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 11
C-B GMVC-10

Test Date	**11/15/94**
Test Time	**1350-1415**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**21**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1465
Engine Speed (rpm)	284
Load (%)	86
Fuel Flow (scf/min)	199
Heat Input (MMBtu/hr) (a)	12.0
Heat Rate (Btu/BHP-hr, HHV)	8323
Heat Rate (Btu/BHP-hr, LHV)	7539
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	6833
Vol. Flow (dscfm) - M19, Fd (b)	6243
Stack Gas Temperature (°F)	561
Moisture (%V)	6.5
O2 (%V, dry)	15.3
CO2 (%V, dry)	3.5
Ambient Conditions	
Barometric Pressure (in. Hg)	26.9
Ambient Temperature (°F)	57
Relative Humidity (%)	26.0
Abs. Humidity (lb H2O/1000 lb dry air)	2.8
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	94
Ethane (%V, dry)	2.55
Propane (%V, dry)	0.35
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
86% Load	**Aldehydes**				
Test Period 21	Acetaldehyde (HAP)	1.8	7.0E-02	3.2E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	17.6	4.9E-01	2.1E+00	1.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	27.3	7.6E-01	3.3E+00	2.3E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	970	1.4E+01	6.3E+01	4.5E+00
	Methanol (HAP)	0.82	2.0E-02	1.1E-01	7.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	77.3	2.0	8.8	0.62
	NMHC	249	3.72	16.2	1.15
	NMEHC	194	2.9	12.7	0.90
	NOx	380	16.3	71.2	5.03
	THC	1219	18.2	79.5	5.62

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
86% Load	Semi-Volatile Organics *				
Test Period 21	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 11
C-B GMVC-10

Test Date	**11/15/94**
Test Time	**1622-1655**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**20**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	1724
Engine Speed (rpm)	285
Load (%)	101
Fuel Flow (scf/min)	224
Heat Input (MMBtu/hr) (a)	13.5
Heat Rate (Btu/BHP-hr, HHV)	7961
Heat Rate (Btu/BHP-hr, LHV)	7211
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7019
Vol. Flow (dscfm) - M19, Fd (b)	6312
Stack Gas Temperature (°F)	583
Moisture (%V)	7.0
O2 (%V, dry)	14.6
CO2 (%V, dry)	3.9
Ambient Conditions	
Barometric Pressure (in. Hg)	26.9
Ambient Temperature (°F)	55
Relative Humidity (%)	29.3
Abs. Humidity (lb H2O/1000 lb dry air)	2.9
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	94
Ethane (%V, dry)	2.55
Propane (%V, dry)	0.35
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
101% Load	**Aldehydes**				
Test Period 20	Acetaldehyde (HAP)	1.8	8.0E-02	3.6E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	13.5	4.2E-01	1.9E+00	1.1E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	22.6	7.1E-01	3.1E+00	1.9E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	838	1.4E+01	6.2E+01	3.7E+00
	Methanol (HAP)	0.72	2.0E-02	1.1E-01	6.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	53.4	1.6	6.9	0.4
	NMHC	65.0	1.1	4.8	0.3
	NMEHC	19.8	0.3	1.5	0.1
	NOx	1338	64.5	282	17.0
	THC	903	15.1	66.3	4.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	Semi-Volatile Organics *				
Test Period 20	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 11
C-B GMVC-10

Test Date	**11/15/94**
Test Time	**1730-1813**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**24**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horsepower (BHP)	1669
Engine Speed (rpm)	292
Load (%)	95
Fuel Flow (scf/min)	221
Heat Input (MMBtu/hr) (a)	13.3
Heat Rate (Btu/BHP-hr, HHV)	8113
Heat Rate (Btu/BHP-hr, LHV)	7349
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7172
Vol. Flow (dscfm) - M19, Fd (b)	6528
Stack Gas Temperature (°F)	576
Moisture (%V)	6.8
O2 (%V, dry)	14.9
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.9
Ambient Temperature (°F)	51
Relative Humidity (%)	36.2
Abs. Humidity (lb H2O/1000 lb dry air)	3.1
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	94
Ethane (%V, dry)	2.55
Propane (%V, dry)	0.35
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
99% Load	**Aldehydes**				
Test Period 24	Acetaldehyde (HAP)	1.92	9.0E-02	3.8E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	15.2	4.7E-01	2.1E+00	1.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	23.3	7.2E-01	3.2E+00	2.0E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	838	1.4E+01	6.1E+01	3.8E+00
	Methanol (HAP)	0.74	2.0E-02	1.1E-01	7.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	64.2	1.9	8.1	0.50
	NMHC	189	3.1	13.7	0.85
	NMEHC	142	2.4	10.3	0.64
	NOx	745	35.4	155	9.6
	THC	1027	17.0	74.3	4.6

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMVC-10 (Engine 11)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
99% Load	Semi-Volatile Organics *				
Test Period 24	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 13
C-B GMWC-10

Test Date	**11/14/94**
Test Time	**1030-1130**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**15**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3500
Rated RPM	NM
Year Installed	1960
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	3352
Engine Speed (rpm)	250
Load (%)	96
Fuel Flow (scf/min)	459
Heat Input (MMBtu/hr) (a)	27.8
Heat Rate (Btu/BHP-hr, HHV)	8423
Heat Rate (Btu/BHP-hr, LHV)	7625
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	14164
Vol. Flow (dscfm) - M19, Fd (b)	13104
Stack Gas Temperature (°F)	653
Moisture (%V)	6.9
O2 (%V, dry)	14.7
CO2 (%V, dry)	3.8
Ambient Conditions	
Barometric Pressure (in. Hg)	26.8
Ambient Temperature (°F)	62
Relative Humidity (%)	24.0
Abs. Humidity (lb H2O/1000 lb dry air)	3.2
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.74
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
96% Load	**Aldehydes**				
Test Period 15	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	28.4	1.8E+00	8.0E+00	2.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	34.1	2.2E+00	9.6E+00	3.0E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1520	5.2E+01	2.3E+02	7.1E+00
	Methanol (HAP)	1.51	1.0E-01	4.6E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	108	6.5	28.5	0.9
	NMHC	219	7.6	33.1	1.0
	NMEHC	151	5.2	22.8	0.7
	NOx	1606	159	697	21.5
	THC	1739	60.0	263	8.1

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
96% Load	Semi-Volatile Organics *				
Test Period 15	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 13
C-B GMWC-10

Test Date	**11/14/94**
Test Time	**1510-1549**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**16**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3500
Rated RPM	NM
Year Installed	1960
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	3054
Engine Speed (rpm)	230
Load (%)	95
Fuel Flow (scf/min)	421
Heat Input (MMBtu/hr) (a)	25.5
Heat Rate (Btu/BHP-hr, HHV)	8478
Heat Rate (Btu/BHP-hr, LHV)	7675
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	12594
Vol. Flow (dscfm) - M19, Fd (b)	11888
Stack Gas Temperature (°F)	651
Moisture (%V)	7.1
O2 (%V, dry)	14.6
CO2 (%V, dry)	4.0
Ambient Conditions	
Barometric Pressure (in. Hg)	26.8
Ambient Temperature (°F)	66
Relative Humidity (%)	20.9
Abs. Humidity (lb H2O/1000 lb dry air)	3.2
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.74
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	**Aldehydes**				
Test Period 16	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	28.7	1.7E+00	7.5E+00	2.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	35.1	2.1E+00	9.1E+00	3.1E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1551	4.9E+01	2.2E+02	7.3E+00
	Methanol (HAP)	1.60	1.0E-01	4.3E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	111	6.1	26.9	0.9
	NMHC	180	5.7	24.9	0.9
	NMEHC	109	3.4	15.1	0.5
	NOx	1971	179	785	26.6
	THC	1756	55.5	243	8.3

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	Semi-Volatile Organics *				
Test Period 16	Acenaphthene	NM	-	-	-
	Acenaphthylene	NM	-	-	-
	Anthracene	NM	-	-	-
	Benz(a)anthracene	NM	-	-	-
	Benzo(a)pyrene	NM	-	-	-
	Benzo(e)pyrene	NM	-	-	-
	Benzo(b)fluoranthene	NM	-	-	-
	Benzo(g,h,i)perylene	NM	-	-	-
	Benzo(k)fluoroanthene	NM	-	-	-
	Biphenyl	NM	-	-	-
	Chysene	NM	-	-	-
	Dibenz(a,h)anthracene	NM	-	-	-
	Fluoranthene	NM	-	-	-
	Fluorene	NM	-	-	-
	Indeno(1,2,3-c,d)pyrene	NM	-	-	-
	2-Methylnaphthalene	NM	-	-	-
	Naphthalene	NM	-	-	-
	Perylene	NM	-	-	-
	Phenanthrene	NM	-	-	-
	Phenol	NM	-	-	-
	Pyrene	NM	-	-	-

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 13
C-B GMWC-10

Test Date	**11/14/94**
Test Time	**1700-1745**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**17**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3500
Rated RPM	NM
Year Installed	1960
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	2822
Engine Speed (rpm)	230
Load (%)	88
Fuel Flow (scf/min)	389
Heat Input (MMBtu/hr) (a)	23.6
Heat Rate (Btu/BHP-hr, HHV)	8481
Heat Rate (Btu/BHP-hr, LHV)	7677
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	12422
Vol. Flow (dscfm) - M19, Fd (b)	11794
Stack Gas Temperature (°F)	615
Moisture (%V)	6.7
O2 (%V, dry)	15.0
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.8
Ambient Temperature (°F)	64
Relative Humidity (%)	24.3
Abs. Humidity (lb H2O/1000 lb dry air)	3.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.74
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period 17	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	26.5	1.5E+00	6.4E+00	2.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	41.3	2.3E+00	1.0E+01	3.7E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1712	5.0E+01	2.2E+02	8.1E+00
	Methanol (HAP)	1.39	8.0E-02	3.6E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	95.4	4.9	21.4	0.8
	NMHC	183	5.4	23.5	0.9
	NMEHC	100.4	2.9	12.9	0.5
	NOx	1432	120	527	19.3
	THC	1895	55.4	243	8.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	Semi-Volatile Organics *				
Test Period 17	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 13
C-B GMWC-10

Test Date	**11/14/94**
Test Time	**1855-1925**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**18**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3500
Rated RPM	NM
Year Installed	1960
Pollution Control	None
Engine Operating Conditions	
Brake horsepower (BHP)	3172
Engine Speed (rpm)	249
Load (%)	91
Fuel Flow (scf/min)	440
Heat Input (MMBtu/hr) (a)	26.6
Heat Rate (Btu/BHP-hr, HHV)	8527
Heat Rate (Btu/BHP-hr, LHV)	7720
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	13942
Vol. Flow (dscfm) - M19, Fd (b)	13514
Stack Gas Temperature (°F)	621
Moisture (%V)	6.8
O2 (%V, dry)	15.1
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.8
Ambient Temperature (°F)	55
Relative Humidity (%)	42.7
Abs. Humidity (lb H2O/1000 lb dry air)	4.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.74
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	**Aldehydes**				
Test Period 18	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	28.7	1.8E+00	7.8E+00	2.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	40.7	2.5E+00	1.1E+01	3.6E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1680	5.6E+01	2.4E+02	8.0E+00
	Methanol (HAP)	1.49	1.0E-01	4.3E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	107	6.2	27.0	0.9
	NMHC	271	9.0	39.2	1.3
	NMEHC	190	6.3	27.4	0.9
	NOx	1226	116	510	16.7
	THC	1951	64.4	282	9.2

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	Semi-Volatile Organics *				
Test Period 18	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6C CEM Results
Engine 13
C-B GMWC-10

Test Date	**11/14/94**
Test Time	**2025-2100**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**23**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3500
Rated RPM	NM
Year Installed	1960
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	3092
Engine Speed (rpm)	240
Load (%)	92
Fuel Flow (scf/min)	426
Heat Input (MMBtu/hr) (a)	25.8
Heat Rate (Btu/BHP-hr, HHV)	8474
Heat Rate (Btu/BHP-hr, LHV)	7671
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	13360
Vol. Flow (dscfm) - M19, Fd (b)	12978
Stack Gas Temperature (°F)	617
Moisture (%V)	6.9
O2 (%V, dry)	15.1
CO2 (%V, dry)	3.7
Ambient Conditions	
Barometric Pressure (in. Hg)	26.9
Ambient Temperature (°F)	51
Relative Humidity (%)	52.5
Abs. Humidity (lb H2O/1000 lb dry air)	4.5
Fuel Gas Analysis	
NG HHV (Btu/scf)	1025
NG LHV (Btu/scf)	928
Methane (%V, dry)	94
Ethane (%V, dry)	2.74
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	48
Benzene (ppmvd)	7.7
Toluene (ppmvd)	8.0
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	1.40
Fd Factor (dscf/MMBtu)	8431

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	**Aldehydes**				
Test Period 23	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	28.4	1.7E+00	7.4E+00	2.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	39.4	2.4E+00	1.0E+01	3.5E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1664	5.3E+01	2.3E+02	7.8E+00
	Methanol (HAP)	1.44	9.0E-02	4.0E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	104	5.8	25.5	0.9
	NMHC	238	7.6	33.4	1.1
	NMEHC	159	5.1	22.4	0.8
	NOx	1464	135	590	19.8
	THC	1902	60.9	267	8.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6C
C-B GMWC-10 (Engine 13)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	Semi-Volatile Organics *				
Test Period 23	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

2-Stroke Clean-Burn

GRI Campaign 1 - Process Conditions
Engine 4
Cooper 10V-275

Test Date	**11/01/93**
Test Time	**1500-1715**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**7**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3750
Rated RPM	275
Year Installed	1969
Pollution Control	CB
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	250
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	503
Moisture (%V)	6.0
O2 (%V, dry)	16.9
CO2 (%V, dry)	2.8
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	95
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.5
Benzene (ppmvd)	1.8
Toluene (ppmvd)	1.8
Ethyl Benzene (ppmvd)	0.3
Xylene (m,p,o) (ppmvd)	0.3

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Cooper 10V-275 (Engine 4)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 7	**Aldehydes**	
	Acetaldehyde (HAP)	2.91
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	NM
	Formaldehyde (HAP)	13.0
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	155
	NMHC	NM
	NMEHC	NM
	NOx	232
	THC	843

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Cooper 10V-275 (Engine 4)

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate	**Semi-Volatile Organics ***	
Load	Acenaphthene	NM
Test Period 7	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 4
Cooper 10V-275

Test Date	**11/02/93**
Test Time	**0900-1144**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**8**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	3750
Rated RPM	275
Year Installed	1969
Pollution Control	CB
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	276
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	543
Moisture (%V)	6.0
O2 (%V, dry)	16.2
CO2 (%V, dry)	3.0
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	95
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.5
Benzene (ppmvd)	1.8
Toluene (ppmvd)	1.8
Ethyl Benzene (ppmvd)	0.3
Xylene (m,p,o) (ppmvd)	0.3

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Cooper 10V-275 (Engine 4)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Full Load	**Aldehydes**	
Test Period 8	Acetaldehyde (HAP)	1.95
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	NM
	Formaldehyde (HAP)	16.6
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	0.005
	1,2,4-Trimethylbenzene	0.02
	1,3-Butadiene (HAP)	ND
	1,3,5-Trimethylbenzene	0.003
	2,2,4-Trimethylpentane (HAP)	0.10
	Acetylene	ND
	Benzene (HAP)	0.19
	Butane	2.20
	Cyclohexane	0.09
	Cyclopentane	0.03
	Ethane	NM
	Ethyl Benzene (HAP)	0.008
	Ethylene	ND
	n-Hexane (HAP)	0.17
	Isobutane	1.67
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	0.07
	n-Nonane	0.001
	n-Octane	0.005
	n-Pentane	NM
	Propane	NM
	Propylene	ND
	Styrene (HAP)	0.02
	Toluene (HAP)	0.11
	Xylene (m,p,o) (HAP)	0.02
	"Criteria" Pollutants	
	CO	138
	NMHC	NM
	NMEHC	NM
	NOx	197
	THC	727

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Cooper 10V-275 (Engine 4)

Test Condition	Pollutant	Concentration (ug/dscf)
Full Load	Semi-Volatile Organics *	
Test Period 8	Acenaphthene	NM
	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 6
Clark TCV-10

Test Date	**11/03/93**
Test Time	**1000-1252**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**9**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1992
Pollution Control	CB
Engine Operating Conditions	
Brake horsepower (BHP)	NM
Engine Speed (rpm)	331
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	445
Moisture (%V)	5.8
O2 (%V, dry)	17.1
CO2 (%V, dry)	2.6
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1032
NG LHV (Btu/scf)	931
Methane (%V, dry)	88
Ethane (%V, dry)	2.4
Propane (%V, dry)	0.38
n-Hexane (ppmvd)	78.3
Benzene (ppmvd)	35.3
Toluene (ppmvd)	12.8
Ethyl Benzene (ppmvd)	1.2
Xylene (m,p,o) (ppmvd)	6.4

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Clark TCV-10 (Engine 6)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Full Load	**Aldehydes**	
Test Period 9	Acetaldehyde (HAP)	4.2
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	48.4
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	ND
	1,2,4-Trimethylbenzene	0.006
	1,3-Butadiene (HAP)	0.07
	1,3,5-Trimethylbenzene	0.003
	2,2,4-Trimethylpentane (HAP)	0.07
	Acetylene	ND
	Benzene (HAP)	0.20
	Butane	1.91
	Cyclohexane	0.10
	Cyclopentane	0.007
	Ethane	NM
	Ethyl Benzene (HAP)	0.01
	Ethylene	ND
	n-Hexane (HAP)	0.24
	Isobutane	1.66
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	0.10
	n-Nonane	0.01
	n-Octane	0.05
	n-Pentane	NM
	Propane	NM
	Propylene	ND
	Styrene (HAP)	0.01
	Toluene (HAP)	0.11
	Xylene (m,p,o) (HAP)	0.05
	"Criteria" Pollutants	
	CO	601
	NMHC	NM
	NMEHC	NM
	NOx	73.2
	THC	2960

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Clark TCV-10 (Engine 6)

Test Condition	Pollutant	Concentration (ug/dscf)
Full Load	Semi-Volatile Organics *	
Test Period 9	Acenaphthene	NM
	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 6
Clark TCV-10

Test Date	**11/03/93**
Test Time	**1330-1608**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**10**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1992
Pollution Control	CB
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	331
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	442
Moisture (%V)	5.8
O2 (%V, dry)	17.1
CO2 (%V, dry)	2.5
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1032
NG LHV (Btu/scf)	931
Methane (%V, dry)	88
Ethane (%V, dry)	2.4
Propane (%V, dry)	0.38
n-Hexane (ppmvd)	78.3
Benzene (ppmvd)	35.3
Toluene (ppmvd)	12.8
Ethyl Benzene (ppmvd)	1.2
Xylene (m,p,o) (ppmvd)	6.4

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Clark TCV-10 (Engine 6)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Full Load	**Aldehydes**	
Test Period 10	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	50.8
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	NM
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	628
	NMHC	NM
	NMEHC	NM
	NOx	69
	THC	3168

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Clark TCV-10 (Engine 6)

Test Condition	Pollutant	Concentration (ug/dscf)
Full Load	Semi-Volatile Organics *	
Test Period 10	Acenaphthene	ND
	Acenaphthylene	ND
	Anthracene	ND
	Benz(a)anthracene	ND
	Benzo(a)pyrene	ND
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	ND
	Benzo(g,h,i)perylene	ND
	Benzo(k)fluoroanthene	ND
	Biphenyl	NM
	Chysene	ND
	Dibenz(a,h)anthracene	ND
	Fluoranthene	ND
	Fluorene	ND
	Indeno(1,2,3-c,d)pyrene	ND
	2-Methylnaphthalene	0.05
	Naphthalene	0.08
	Perylene	NM
	Phenanthrene	0.007
	Phenol	0.32
	Pyrene	ND

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/25/94**
Test Time	**1705-1906**
Load Condition	**Full**
Sampling Location	**Before Catalyst**
Test Period	**7**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horespower (BHP)	1732
Engine Speed (rpm)	299
Load (%)	97
Fuel Flow (scf/min)	211
Heat Input (MMBtu/hr) (a)	12.6
Heat Rate (Btu/BHP-hr, HHV)	7368
Heat Rate (Btu/BHP-hr, LHV)	6640
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	8486
Vol. Flow (dscfm) - M19, Fd (b)	6920
Stack Gas Temperature (°F)	574
Moisture (%V)	7.3
O2 (%V, dry)	15.5
CO2 (%V, dry)	2.9
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	85
Relative Humidity (%)	37.8
Abs. Humidity (lb H2O/1000 lb dry air)	10.1
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	93
Ethane (%V, dry)	2.9
Propane (%V, dry)	0.45
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8470

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
97% Load	**Aldehydes**				
Test Period 7	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.03	2.3E-03	1.0E-02	6.1E-04
	Formaldehyde (HAP)	22.2	6.6E-01	2.9E+00	1.7E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	47.7	1.4E+00	6.2E+00	3.7E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.0	3.0E-02	1.3E-01	8.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	179	4.9	21.4	1.3
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	43.1	1.9	8.5	0.5
	THC	1446	22.6	99.1	5.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
97% Load	Semi-Volatile Organics *				
Test Period 7	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/26/94**
Test Time	**1310-1537**
Load Condition	**Full**
Sampling Location	**Before Catalyst**
Test Period	**9**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horespower (BHP)	1674
Engine Speed (rpm)	300
Load (%)	93
Fuel Flow (scf/min)	213
Heat Input (MMBtu/hr) (a)	12.7
Heat Rate (Btu/BHP-hr, HHV)	7706
Heat Rate (Btu/BHP-hr, LHV)	6945
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	NM
Vol. Flow (dscfm) - M19, Fd (b)	6866
Stack Gas Temperature (°F)	517
Moisture (%V)	7.3
O2 (%V, dry)	15.4
CO2 (%V, dry)	3.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	89
Relative Humidity (%)	40.5
Abs. Humidity (lb H2O/1000 lb dry air)	12.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	94
Ethane (%V, dry)	2.5
Propane (%V, dry)	0.36
n-Hexane (ppmvd)	64.2
Benzene (ppmvd)	9.6
Toluene (ppmvd)	13.8
Ethyl Benzene (ppmvd)	1.1
Xylene (m,p,o) (ppmvd)	5.3
Fd Factor (dscf/MMBtu)	8471

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
93% Load	**Aldehydes**				
Test Period 9	Acetaldehyde (HAP)	1.76	8.0E-02	3.4E-01	2.0E-02
	Acrolein (HAP)	2.0	1.1E-01	4.9E-01	3.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	23.6	7.1E-01	3.1E+00	1.9E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	ND	--	--	--
	1,2,4-Trimethylbenzene	0.004	4.2E-04	1.9E-03	1.2E-04
	1,3-Butadiene (HAP)	0.03	1.6E-03	6.9E-03	4.2E-04
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	0.02	2.5E-03	1.1E-02	6.8E-04
	Acetylene	NM	--	--	--
	Benzene (HAP)	0.05	3.8E-03	1.7E-02	1.0E-03
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	0.02	1.3E-03	5.8E-03	3.6E-04
	Ethane	48.5	1.5E+00	6.3E+00	3.9E-01
	Ethyl Benzene (HAP)	ND	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	0.12	1.0E-02	4.4E-02	2.7E-03
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.4	1.0E-02	5.0E-02	3.0E-03
	Methylcyclohexane	0.06	6.1E-03	2.7E-02	1.6E-03
	n-Nonane	0.006	7.9E-04	3.5E-03	2.1E-04
	n-Octane	0.02	2.3E-03	1.0E-02	6.2E-04
	n-Pentane	0.32	2.2E-02	9.7E-02	6.0E-03
	Propane	8.75	3.7E-01	1.6E+00	1.0E-01
	Propylene	NM	--	--	--
	Styrene (HAP)	ND	--	--	--
	Toluene (HAP)	0.04	3.3E-03	1.5E-02	9.0E-04
	Xylene (m,p,o) (HAP)	0.01	1.5E-03	6.4E-03	4.0E-04
	"Criteria" Pollutants				
	CO	195	5.4	23.7	1.5
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	36.9	1.7	7.4	0.5
	THC	1817	28.8	126	7.8

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
93% Load	Semi-Volatile Organics *				
Test Period 9	Acenaphthene	0.0005	4.4E-07	1.9E-06	1.2E-07
	Acenaphthylene	0.001	1.3E-06	5.8E-06	3.6E-07
	Anthracene	0.0003	2.9E-07	1.3E-06	7.7E-08
	Benz(a)anthracene	0.0001	1.1E-07	4.9E-07	3.0E-08
	Benzo(a)pyrene	0.0001	7.7E-08	3.4E-07	2.1E-08
	Benzo(e)pyrene	0.0003	3.0E-07	1.3E-06	8.1E-08
	Benzo(b)fluoranthene	0.0001	1.0E-07	4.6E-07	2.8E-08
	Benzo(g,h,i)perylene	0.0004	3.2E-07	1.4E-06	8.7E-08
	Benzo(k)fluoroanthene	0.00006	5.0E-08	2.2E-07	1.4E-08
	Biphenyl	NM	--	--	--
	Chysene	0.0003	2.3E-07	1.0E-06	6.2E-08
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.0009	8.4E-07	3.7E-06	2.3E-07
	Fluorene	0.0008	7.7E-07	3.4E-06	2.1E-07
	Indeno(1,2,3-c,d)pyrene	0.0001	1.3E-07	5.5E-07	3.4E-08
	2-Methylnaphthalene	0.007	5.9E-06	2.6E-05	1.6E-06
	Naphthalene	0.026	2.4E-05	1.0E-04	6.4E-06
	Perylene	0.00007	6.0E-08	2.6E-07	1.6E-08
	Phenanthrene	0.003	2.6E-06	1.1E-05	7.0E-07
	Phenol	NM	--	--	--
	Pyrene	0.001	1.3E-06	5.5E-06	3.4E-07

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/30/94**
Test Time	**1555-1618**
Load Condition	**Full**
Sampling Location	**Before Catalyst**
Test Period	**H**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horespower (BHP)	1705
Engine Speed (rpm)	299
Load (%)	95
Fuel Flow (scf/min)	212
Heat Input (MMBtu/hr) (a)	12.7
Heat Rate (Btu/BHP-hr, HHV)	7550
Heat Rate (Btu/BHP-hr, LHV)	6803
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	8338
Vol. Flow (dscfm) - M19, Fd (b)	6633
Stack Gas Temperature (°F)	506
Moisture (%V)	8.2
O2 (%V, dry)	15.3
CO2 (%V, dry)	2.9
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	85
Relative Humidity (%)	29.4
Abs. Humidity (lb H2O/1000 lb dry air)	8.0
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

NM - Not measured.

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	**Aldehydes**				
Test Period H	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.7	9.0E-02	4.2E-01	3.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	16.1	4.7E-01	2.1E+00	1.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.7	2.0E-02	1.0E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	186	5.2	22.5	1.4
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	38.6	1.8	7.7	0.5
	THC	1624	25.6	112	6.8

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	Semi-Volatile Organics *				
Test Period H	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/30/94**
Test Time	**1656-1735**
Load Condition	**Low**
Sampling Location	**Before Catalyst**
Test Period	**I**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horespower (BHP)	1422
Engine Speed (rpm)	299
Load (%)	79
Fuel Flow (scf/min)	185
Heat Input (MMBtu/hr) (a)	11.0
Heat Rate (Btu/BHP-hr, HHV)	7880
Heat Rate (Btu/BHP-hr, LHV)	7100
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	8371
Vol. Flow (dscfm) - M19, Fd (b)	6039
Stack Gas Temperature (°F)	507
Moisture (%V)	8.0
O2 (%V, dry)	15.5
CO2 (%V, dry)	2.8
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	84
Relative Humidity (%)	44.8
Abs. Humidity (lb H2O/1000 lb dry air)	11.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
79% Load	**Aldehydes**				
Test Period I	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	2.8	1.3E-01	5.8E-01	4.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	27.9	7.2E-01	3.2E+00	2.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.1	3.0E-02	1.3E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	260	6.3	27.4	2.0
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	22.1	0.87	3.8	0.28
	THC	2317	31.8	139	10.2

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
79% Load	Semi-Volatile Organics *				
Test Period I	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

2-Stroke Clean-Burn (CO Catalyst)

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/26/94**
Test Time	**1051-1226**
Load Condition	**Full**
Sampling Location	**After Catalyst**
Test Period	**8**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horespower (BHP)	1773
Engine Speed (rpm)	299
Load (%)	99
Fuel Flow (scf/min)	211
Heat Input (MMBtu/hr) (a)	12.6
Heat Rate (Btu/BHP-hr, HHV)	7199
Heat Rate (Btu/BHP-hr, LHV)	6488
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	8751
Vol. Flow (dscfm) - M19, Fd (b)	6696
Stack Gas Temperature (°F)	517
Moisture (%V)	7.3
O2 (%V, dry)	15.4
CO2 (%V, dry)	3.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	84
Relative Humidity (%)	47.8
Abs. Humidity (lb H2O/1000 lb dry air)	12.5
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	94
Ethane (%V, dry)	2.5
Propane (%V, dry)	0.36
n-Hexane (ppmvd)	64.2
Benzene (ppmvd)	9.6
Toluene (ppmvd)	13.8
Ethyl Benzene (ppmvd)	1.1
Xylene (m,p,o) (ppmvd)	5.3
Fd Factor (dscf/MMBtu)	8471

a Based on HHV

b Used in emission calculations.

NM - Not measured.

11/13/95 C4E4T8.WK4

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
99% Load	**Aldehydes**				
Test Period 8	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.6	8.0E-02	3.7E-01	2.0E-02
	Butyr/Isobutyraldehyde	0.02	1.5E-03	6.7E-03	3.9E-04
	Formaldehyde (HAP)	8.8	2.6E-01	1.1E+00	7.0E-02
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	15.1	0.4	1.8	0.1
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	46.9	2.1	9.3	0.5
	THC	1559	24.4	107	6.3

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
99% Load	**Semi-Volatile Organics ***				
Test Period 8	Acenaphthene	NM	-	-	-
	Acenaphthylene	NM	-	-	-
	Anthracene	NM	-	-	-
	Benz(a)anthracene	NM	-	-	-
	Benzo(a)pyrene	NM	-	-	-
	Benzo(e)pyrene	NM	-	-	-
	Benzo(b)fluoranthene	NM	-	-	-
	Benzo(g,h,i)perylene	NM	-	-	-
	Benzo(k)fluoroanthene	NM	-	-	-
	Biphenyl	NM	-	-	-
	Chysene	NM	-	-	-
	Dibenz(a,h)anthracene	NM	-	-	-
	Fluoranthene	NM	-	-	-
	Fluorene	NM	-	-	-
	Indeno(1,2,3-c,d)pyrene	NM	-	-	-
	2-Methylnaphthalene	NM	-	-	-
	Naphthalene	NM	-	-	-
	Perylene	NM	-	-	-
	Phenanthrene	NM	-	-	-
	Phenol	NM	-	-	-
	Pyrene	NM	-	-	-

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 4
C-B GMVC-10C

Test Date	**8/26/94**
Test Time	**1620-1821**
Load Condition	**Intermediate**
Sampling Location	**After Catalyst**
Test Period	**10**
Unit Description	
Engine Type	2-Stroke, TC
Rated BHP	1800
Rated RPM	300
Year Installed	1956
Pollution Control	CB, CO Catalyst
Engine Operating Conditions	
Brake horsepower (BHP)	1600
Engine Speed (rpm)	300
Load (%)	89
Fuel Flow (scf/min)	203
Heat Input (MMBtu/hr) (a)	12.1
Heat Rate (Btu/BHP-hr, HHV)	7699
Heat Rate (Btu/BHP-hr, LHV)	6938
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	NM
Vol. Flow (dscfm) - M19, Fd (b)	6592
Stack Gas Temperature (°F)	517
Moisture (%V)	7.3
O2 (%V, dry)	15.5
CO2 (%V, dry)	3.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	86
Relative Humidity (%)	42.6
Abs. Humidity (lb.H2O/1000 lb dry air)	11.8
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	94
Ethane (%V, dry)	2.5
Propane (%V, dry)	0.36
n-Hexane (ppmvd)	64.2
Benzene (ppmvd)	9.6
Toluene (ppmvd)	13.8
Ethyl Benzene (ppmvd)	1.1
Xylene (m,p,o) (ppmvd)	5.3
Fd Factor (dscf/MMBtu)	8471

a Based on HHV

b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
89% Load	**Aldehydes**				
Test Period 10	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.5	8.0E-02	3.5E-01	2.0E-02
	Butyr/Isobutyraldehyde	0.02	1.5E-03	6.6E-03	4.3E-04
	Formaldehyde (HAP)	5.3	1.5E-01	6.5E-01	4.0E-02
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	13.8	0.4	1.6	0.1
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	35.9	1.6	6.8	0.4
	THC	1837	27.8	122	7.9

ND=Non-detect
NM=Not Measured

12/01/95 C4E4T10.WK4

Emission Summary
GRI Campaign 4
C-B GMVC-10C

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
89% Load	Semi-Volatile Organics *				
Test Period 10	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

4-Stroke Rich-Burn

GRI Campaign 1 - Process Conditions
Engine 2
Ingersoll KVG

Test Date	**10/29/93**
Test Time	**1000-1330**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**1**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	327
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	945
Moisture (%V)	16.8
O2 (%V, dry)	4.3
CO2 (%V, dry)	8.4
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.3
Benzene (ppmvd)	1.5
Toluene (ppmvd)	1.7
Ethyl Benzene (ppmvd)	0.1
Xylene (m,p,o) (ppmvd)	1.1

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 1	**Aldehydes**	
	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	NM
	Formaldehyde (HAP)	1.2
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	0.0004
	1,2,4-Trimethylbenzene	0.08
	1,3-Butadiene (HAP)	ND
	1,3,5-Trimethylbenzene	0.0004
	2,2,4-Trimethylpentane (HAP)	0.002
	Acetylene	ND
	Benzene (HAP)	0.10
	Butane	0.11
	Cyclohexane	0.003
	Cyclopentane	0.005
	Ethane	NM
	Ethyl Benzene (HAP)	0.002
	Ethylene	ND
	n-Hexane (HAP)	0.008
	Isobutane	0.04
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	0.002
	n-Nonane	0.001
	n-Octane	0.001
	n-Pentane	0.001
	Propane	0.001
	Propylene	ND
	Styrene (HAP)	0.001
	Toluene (HAP)	0.03
	Xylene (m,p,o) (HAP)	0.006
	"Criteria" Pollutants	
	CO	1879
	NMHC	NM
	NMEHC	NM
	NOx	492
	THC	94

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate Load Test Period 1	**Semi-Volatile Organics ***	
	Acenaphthene	NM
	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 2
Ingersoll KVG

Test Date	**10/29/93**
Test Time	**1607-1910**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**2**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	327
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	945
Moisture (%V)	16.8
O2 (%V, dry)	4.1
CO2 (%V, dry)	8.6
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.3
Benzene (ppmvd)	1.5
Toluene (ppmvd)	1.7
Ethyl Benzene (ppmvd)	0.1
Xylene (m,p,o) (ppmvd)	1.1

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 2	**Aldehydes**	
	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	1.27
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	2123
	NMHC	NM
	NMEHC	NM
	NOx	475
	THC	95

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate	Semi-Volatile Organics *	
Load	Acenaphthene	NM
Test Period 2	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 2
Ingersoll KVG

Test Date	**10/30/93**
Test Time	**0935-1150**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**3**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	328
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	940
Moisture (%V)	16.4
O2 (%V, dry)	4.8
CO2 (%V, dry)	8.3
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.3
Benzene (ppmvd)	1.5
Toluene (ppmvd)	1.7
Ethyl Benzene (ppmvd)	0.1
Xylene (m,p,o) (ppmvd)	1.1

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 3	**Aldehydes**	
	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	1.23
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	0.6
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	1466
	NMHC	NM
	NMEHC	NM
	NOx	562
	THC	84

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate	Semi-Volatile Organics *	
Load	Acenaphthene	NM
Test Period 3	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 2
Ingersoll KVG

Test Date	**10/30/93**
Test Time	**1420-1655**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**4**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	291
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	798
Moisture (%V)	15.0
O2 (%V, dry)	2.0
CO2 (%V, dry)	9.5
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	89.3
Benzene (ppmvd)	1.5
Toluene (ppmvd)	1.7
Ethyl Benzene (ppmvd)	0.1
Xylene (m,p,o) (ppmvd)	1.1

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Low Load	**Aldehydes**	
Test Period 4	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	1.37
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	ND
	1,2,4-Trimethylbenzene	0.15
	1,3-Butadiene (HAP)	ND
	1,3,5-Trimethylbenzene	ND
	2,2,4-Trimethylpentane (HAP)	0.002
	Acetylene	ND
	Benzene (HAP)	0.06
	Butane	0.06
	Cyclohexane	0.002
	Cyclopentane	ND
	Ethane	NM
	Ethyl Benzene (HAP)	0.002
	Ethylene	ND
	n-Hexane (HAP)	0.01
	Isobutane	0.15
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	0.002
	n-Nonane	ND
	n-Octane	0.002
	n-Pentane	NM
	Propane	NM
	Propylene	ND
	Styrene (HAP)	0.001
	Toluene (HAP)	0.02
	Xylene (m,p,o) (HAP)	0.001
	"Criteria" Pollutants	
	CO	1273
	NMHC	NM
	NMEHC	NM
	NOx	537
	THC	114

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 2)

Test Condition	Pollutant	Concentration (ug/dscf)
Low Load	**Semi-Volatile Organics ***	
Test Period 4	Acenaphthene	NM
	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 3
Ingersoll KVG

Test Date	**10/31/93**
Test Time	**1008-1326**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**5**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	328
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	842
Moisture (%V)	13.3
O2 (%V, dry)	8.8
CO2 (%V, dry)	6.7
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	88.1
Benzene (ppmvd)	1.8
Toluene (ppmvd)	1.8
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	0.9

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 3)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Full Load	**Aldehydes**	
Test Period 5	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	5.85
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	ND
	1,2,4-Trimethylbenzene	0.005
	1,3-Butadiene (HAP)	ND
	1,3,5-Trimethylbenzene	ND
	2,2,4-Trimethylpentane (HAP)	0.004
	Acetylene	ND
	Benzene (HAP)	0.03
	Butane	0.07
	Cyclohexane	0.002
	Cyclopentane	0.03
	Ethane	NM
	Ethyl Benzene (HAP)	0.003
	Ethylene	ND
	n-Hexane (HAP)	0.02
	Isobutane	0.12
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	0.004
	n-Nonane	0.002
	n-Octane	0.003
	n-Pentane	NM
	Propane	NM
	Propylene	ND
	Styrene (HAP)	ND
	Toluene (HAP)	0.02
	Xylene (m,p,o) (HAP)	0.006
	"Criteria" Pollutants	
	CO	38.6
	NMHC	NM
	NMEHC	NM
	NOx	1015
	THC	132

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 3)

Test Condition	Pollutant	Concentration (ug/dscf)
Full Load	**Semi-Volatile Organics ***	
Test Period 5	Acenaphthene	0.002
	Acenaphthylene	0.02
	Anthracene	0.001
	Benz(a)anthracene	ND
	Benzo(a)pyrene	ND
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	ND
	Benzo(g,h,i)perylene	ND
	Benzo(k)fluoroanthene	ND
	Biphenyl	NM
	Chysene	ND
	Dibenz(a,h)anthracene	ND
	Fluoranthene	0.003
	Fluorene	0.004
	Indeno(1,2,3-c,d)pyrene	ND
	2-Methylnaphthalene	0.05
	Naphthalene	0.32
	Perylene	ND
	Phenanthrene	0.01
	Phenol	0.37
	Pyrene	0.002

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 3
Ingersoll KVG

Test Date	**10/31/93**
Test Time	**1520-1756**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**6**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	328
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	775
Moisture (%V)	12.0
O2 (%V, dry)	10.1
CO2 (%V, dry)	5.8
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Methane (%V, dry)	94
Ethane (%V, dry)	2.6
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	88.1
Benzene (ppmvd)	1.8
Toluene (ppmvd)	1.8
Ethyl Benzene (ppmvd)	ND
Xylene (m,p,o) (ppmvd)	0.9

a Based on HHV

NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 3)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 6	**Aldehydes**	
	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	ND
	Formaldehyde (HAP)	7.1
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	47.2
	NMHC	NM
	NMEHC	NM
	NOx	917
	THC	335

ND=Non-detect

NM=Not Measured

12/01/95

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Emission Summary
GRI Campaign 1
Ingersoll KVG (Engine 3)

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate	Semi-Volatile Organics *	
Load	Acenaphthene	NM
Test Period 6	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 1 - Process Conditions
Engine 1
Ingersoll KVG

Test Date	**11/04/93**
Test Time	**0746-1334**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**11**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	1100
Rated RPM	330
Year Installed	1962
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	NM
Engine Speed (rpm)	327
Load (%)	NA
Fuel Flow (scf/min)	NA
Heat Input (MMBtu/hr) (a)	NA
Heat Rate (Btu/BHP-hr, HHV)	NM
Heat Rate (Btu/BHP-hr, LHV)	NM
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	NM
Moisture (%V)	12.0
O2 (%V, dry)	6.2
CO2 (%V, dry)	6.9
Ambient Conditions	
Barometric Pressure (in. Hg)	NM
Ambient Temperature (°F)	NM
Relative Humidity (%)	NM
Abs. Humidity (lb H2O/1000 lb dry air)	NM
Fuel Gas Analysis	
NG HHV (Btu/scf)	NM
NG LHV (Btu/scf)	NM
Methane (%V, dry)	NM
Ethane (%V, dry)	NM
Propane (%V, dry)	NM
n-Hexane (ppmvd)	NM
Benzene (ppmvd)	NM
Toluene (ppmvd)	NM
Ethyl Benzene (ppmvd)	NM
Xylene (m,p,o) (ppmvd)	NM

a Based on HHV
NM - Not measured.

Emission Summary
GRI Campaign 1
Ingersoll KVG

Test Condition	Pollutant	Concentration (ppmvd @15%O2)
Intermediate Load Test Period 11	**Aldehydes**	
	Acetaldehyde (HAP)	ND
	Acrolein (HAP)	ND
	Butyr/Isobutyraldehyde	NM
	Formaldehyde (HAP)	1.69
	Propionaldehyde (HAP)	NM
	Volatile Organics	
	1,2,3-Trimethylbenzene	NM
	1,2,4-Trimethylbenzene	NM
	1,3-Butadiene (HAP)	NM
	1,3,5-Trimethylbenzene	NM
	2,2,4-Trimethylpentane (HAP)	NM
	Acetylene	NM
	Benzene (HAP)	NM
	Butane	NM
	Cyclohexane	NM
	Cyclopentane	NM
	Ethane	NM
	Ethyl Benzene (HAP)	NM
	Ethylene	NM
	n-Hexane (HAP)	NM
	Isobutane	NM
	Methane	NM
	Methanol (HAP)	ND
	Methylcyclohexane	NM
	n-Nonane	NM
	n-Octane	NM
	n-Pentane	NM
	Propane	NM
	Propylene	NM
	Styrene (HAP)	NM
	Toluene (HAP)	NM
	Xylene (m,p,o) (HAP)	NM
	"Criteria" Pollutants	
	CO	3892
	NMHC	NM
	NMEHC	NM
	NOx	321
	THC	138

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 1
Ingersoll KVG

Test Condition	Pollutant	Concentration (ug/dscf)
Intermediate	Semi-Volatile Organics *	
Load	Acenaphthene	NM
Test Period 11	Acenaphthylene	NM
	Anthracene	NM
	Benz(a)anthracene	NM
	Benzo(a)pyrene	NM
	Benzo(e)pyrene	NM
	Benzo(b)fluoranthene	NM
	Benzo(g,h,i)perylene	NM
	Benzo(k)fluoroanthene	NM
	Biphenyl	NM
	Chysene	NM
	Dibenz(a,h)anthracene	NM
	Fluoranthene	NM
	Fluorene	NM
	Indeno(1,2,3-c,d)pyrene	NM
	2-Methylnaphthalene	NM
	Naphthalene	NM
	Perylene	NM
	Phenanthrene	NM
	Phenol	NM
	Pyrene	NM

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Waukesha Engine
Waukesha L7042GU

Test Date	**8/23/94**
Test Time	**1805-2028**
Load Condition	**Intermediate**
Sampling Location	**Before NSCR**
Test Period	**3**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	896
Rated RPM	1000
Year Installed	1982
Pollution Control	NSCR
Engine Operating Conditions	
Brake horespower (BHP)	644
Engine Speed (rpm)	813
Load (%)	88
Fuel Flow (scf/min)	83
Heat Input (MMBtu/hr) (a)	5.0
Heat Rate (Btu/BHP-hr, HHV)	7809
Heat Rate (Btu/BHP-hr, LHV)	7035
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	1274
Vol. Flow (dscfm) - M19, Fd (b)	716
Stack Gas Temperature (°F)	796
Moisture (%V)	20.7
O2 (%V, dry)	0.4
CO2 (%V, dry)	11.2
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	74
Relative Humidity (%)	65.4
Abs. Humidity (lb H2O/1000 lb dry air)	12.0
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	93
Ethane (%V, dry)	2.8
Propane (%V, dry)	0.38
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8499

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period 3	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.009	4.3E-04	1.9E-03	3.0E-04
	Formaldehyde (HAP)	6.6	1.4E-01	6.0E-01	1.0E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.2	3.0E-02	1.2E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	1070	20.6	90.3	14.5
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	819	25.9	114	18.3
	THC	381	4.2	18.4	3.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	Semi-Volatile Organics *				
Test Period 3	Acenaphthene	NM	-	-	-
	Acenaphthylene	NM	-	-	-
	Anthracene	NM	-	-	-
	Benz(a)anthracene	NM	-	-	-
	Benzo(a)pyrene	NM	-	-	-
	Benzo(e)pyrene	NM	-	-	-
	Benzo(b)fluoranthene	NM	-	-	-
	Benzo(g,h,i)perylene	NM	-	-	-
	Benzo(k)fluoroanthene	NM	-	-	-
	Biphenyl	NM	-	-	-
	Chysene	NM	-	-	-
	Dibenz(a,h)anthracene	NM	-	-	-
	Fluoranthene	NM	-	-	-
	Fluorene	NM	-	-	-
	Indeno(1,2,3-c,d)pyrene	NM	-	-	-
	2-Methylnaphthalene	NM	-	-	-
	Naphthalene	NM	-	-	-
	Perylene	NM	-	-	-
	Phenanthrene	NM	-	-	-
	Phenol	NM	-	-	-
	Pyrene	NM	-	-	-

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Waukesha Engine
Waukesha L7042GU

Test Date	**8/24/94**
Test Time	**1020-1201**
Load Condition	**Low**
Sampling Location	**Before NSCR**
Test Period	**4**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	896
Rated RPM	1000
Year Installed	1982
Pollution Control	NSCR
Engine Operating Conditions	
Brake horespower (BHP)	362
Engine Speed (rpm)	779
Load (%)	52
Fuel Flow (scf/min)	55
Heat Input (MMBtu/hr) (a)	3.3
Heat Rate (Btu/BHP-hr, HHV)	9185
Heat Rate (Btu/BHP-hr, LHV)	8279
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	474
Vol. Flow (dscfm) - M19, Fd (b)	472
Stack Gas Temperature (°F)	641
Moisture (%V)	20.5
O2 (%V, dry)	0.4
CO2 (%V, dry)	11.5
Ambient Conditions	
Barometric Pressure (in. Hg)	29.6
Ambient Temperature (°F)	87
Relative Humidity (%)	36.7
Abs. Humidity (lb H2O/1000 lb dry air)	10.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1013
NG LHV (Btu/scf)	913
Methane (%V, dry)	93
Ethane (%V, dry)	2.9
Propane (%V, dry)	0.45
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8470

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
52% Load	**Aldehydes**				
Test Period 4	Acetaldehyde (HAP)	0.76	9.0E-03	4.0E-02	1.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	7.0	5.0E-02	2.4E-01	7.0E-02
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.2	1.0E-02	4.0E-02	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	772	5.6	24.3	7.0
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	730	8.6	37.8	10.8
	THC	504	2.1	9.1	2.6

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
52% Load	Semi-Volatile Organics *				
Test Period 4	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

4-Stroke Rich-Burn (NSCR)

GRI Campaign 4 - Process Conditions
Waukesha Engine
Waukesha L7042GU

Test Date	**8/23/94**
Test Time	**1146-1345**
Load Condition	**Full**
Sampling Location	**After NSCR**
Test Period	**1**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	896
Rated RPM	1000
Year Installed	1982
Pollution Control	NSCR
Engine Operating Conditions	
Brake horespower (BHP)	692
Engine Speed (rpm)	809
Load (%)	95
Fuel Flow (scf/min)	88
Heat Input (MMBtu/hr) (a)	5.3
Heat Rate (Btu/BHP-hr, HHV)	7717
Heat Rate (Btu/BHP-hr, LHV)	6952
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	1274
Vol. Flow (dscfm) - M19, Fd (b)	746
Stack Gas Temperature (°F)	796
Moisture (%V)	20.7
O2 (%V, dry)	0.04
CO2 (%V, dry)	11.7
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	87
Relative Humidity (%)	35.2
Abs. Humidity (lb H2O/1000 lb dry air)	10.1
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	93
Ethane (%V, dry)	2.8
Propane (%V, dry)	0.38
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8499

a Based on HHV

b Used in emission calculations.

NM - Not measured.

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	**Aldehydes**				
Test Period 1	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.0	4.0E-02	1.7E-01	3.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	ND	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.9	2.0E-02	9.0E-02	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	19.4	0.4	1.7	0.3
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	2.3	0.07	0.3	0.05
	THC	217	2.4	10.6	1.6

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	Semi-Volatile Organics *				
Test Period 1	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Waukesha Engine
Waukesha L7042GU

Test Date	**8/23/94**
Test Time	**1424-1722**
Load Condition	**Full**
Sampling Location	**After NSCR**
Test Period	**2**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	896
Rated RPM	1000
Year Installed	1982
Pollution Control	NSCR
Engine Operating Conditions	
Brake horespower (BHP)	671
Engine Speed (rpm)	811
Load (%)	92
Fuel Flow (scf/min)	85
Heat Input (MMBtu/hr) (a)	5.1
Heat Rate (Btu/BHP-hr, HHV)	7646
Heat Rate (Btu/BHP-hr, LHV)	6888
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	1274
Vol. Flow (dscfm) - M19, Fd (b)	718
Stack Gas Temperature (°F)	796
Moisture (%V)	20.7
O2 (%V, dry)	0.06
CO2 (%V, dry)	11.7
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	87
Relative Humidity (%)	40.1
Abs. Humidity (lb H2O/1000 lb dry air)	11.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	93
Ethane (%V, dry)	2.8
Propane (%V, dry)	0.38
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8499

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	**Aldehydes**				
Test Period 2	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.4	5.0E-02	2.4E-01	4.0E-02
	Butyr/Isobutyraldehyde	0.003	1.4E-04	6.3E-04	9.7E-05
	Formaldehyde (HAP)	ND	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.0	2.0E-02	1.0E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	19.7	0.4	1.7	0.3
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	2.4	0.08	0.3	0.05
	THC	228	2.6	11.2	1.7

ND=Non-detect

NM=Not Measured

12/01/95

C4WAUKT2.WK4

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant:	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	Semi-Volatile Organics *				
Test Period 2	Acenaphthene	0.001	2.1E-07	9.2E-07	1.4E-07
	Acenaphthylene	0.007	1.2E-06	5.5E-06	8.4E-07
	Anthracene	0.005	8.8E-07	3.8E-06	5.9E-07
	Benz(a)anthracene	0.001	2.1E-07	9.2E-07	1.4E-07
	Benzo(a)pyrene	0.0003	5.6E-08	2.5E-07	3.8E-08
	Benzo(e)pyrene	0.0006	1.0E-07	4.4E-07	6.8E-08
	Benzo(b)fluoranthene	0.001	1.4E-07	6.3E-07	3.9E-08
	Benzo(g,h,i)perylene	0.0003	5.8E-08	2.5E-07	3.9E-08
	Benzo(k)fluoroanthene	0.0004	6.7E-08	2.9E-07	4.5E-08
	Biphenyl	NM	--	--	--
	Chysene	0.001	2.3E-07	1.0E-06	1.5E-07
	Dibenz(a,h)anthracene	0.0001	1.7E-08	7.4E-08	1.1E-08
	Fluoranthene	0.005	8.1E-07	3.5E-06	5.5E-07
	Fluorene	0.005	8.9E-07	3.9E-06	6.1E-07
	Indeno(1,2,3-c,d)pyrene	0.0002	3.3E-08	1.5E-07	2.3E-08
	2-Methylnaphthalene	0.02	2.8E-06	1.2E-05	1.9E-06
	Naphthalene	0.14	2.3E-05	1.0E-04	1.5E-05
	Perylene	0.00008	1.4E-08	6.1E-08	9.4E-09
	Phenanthrene	0.03	4.2E-06	1.8E-05	2.8E-06
	Phenol	NM	--	--	--
	Pyrene	0.005	8.2E-07	3.6E-06	5.6E-07

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

12/01/95

C4WAUKT2.WK4

GRI Campaign 4 - Process Conditions
Waukesha Engine
Waukesha L7042GU

Test Date	**8/24/94**
Test Time	**1210-1306**
Load Condition	**Low**
Sampling Location	**After NSCR**
Test Period	**5**
Unit Description	
Engine Type	4-Stroke, RB
Rated BHP	896
Rated RPM	1000
Year Installed	1982
Pollution Control	NSCR
Engine Operating Conditions	
Brake horespower (BHP)	359
Engine Speed (rpm)	779
Load (%)	51
Fuel Flow (scf/min)	55
Heat Input (MMBtu/hr) (a)	3.3
Heat Rate (Btu/BHP-hr, HHV)	9275
Heat Rate (Btu/BHP-hr, LHV)	8360
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	474
Vol. Flow (dscfm) - M19, Fd (b)	464
Stack Gas Temperature (°F)	641
Moisture (%V)	20.5
O2 (%V, dry)	0.0
CO2 (%V, dry)	12.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	92
Relative Humidity (%)	27.2
Abs. Humidity (lb H2O/1000 lb dry air)	9.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1013
NG LHV (Btu/scf)	913
Methane (%V, dry)	93
Ethane (%V, dry)	2.9
Propane (%V, dry)	0.45
n-Hexane (ppmvd)	63.6
Benzene (ppmvd)	9.8
Toluene (ppmvd)	13.4
Ethyl Benzene (ppmvd)	1.0
Xylene (m,p,o) (ppmvd)	4.1
Fd Factor (dscf/MMBtu)	8470

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
51% Load	**Aldehydes**				
Test Period 5	Acetaldehyde (HAP)	NM	--	--	--
	Acrolein (HAP)	NM	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	NM	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	NM	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	10.1	0.07	0.3	0.09
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	10.0	0.12	0.5	0.15
	THC	301	1.3	5.5	1.6

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
Waukesha L7042GU

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
51% Load	Semi-Volatile Organics *				
Test Period 5	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

4-Stroke Lean-Burn

GRI Campaign 3 - Station 3A Process Conditions
Engine 102
CB LSV-16

Test Date	**06/14/94**
Test Time	**1600-2100**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**1**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	4055
Engine Speed (rpm)	321
Load (%)	98
Fuel Flow (scf/min)	487
Heat Input (MMBtu/hr) (a)	33.3
Heat Rate (Btu/BHP-hr, HHV)	8348
Heat Rate (Btu/BHP-hr, LHV)	7556
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7381
Vol. Flow (dscfm) - M19, Fd (b)	8735
Stack Gas Temperature (°F)	976
Moisture (%V)	13.0
O2 (%V, dry)	9.6
CO2 (%V, dry)	6.3
Ambient Conditions	
Barometric Pressure (in. Hg)	29.2
Ambient Temperature (°F)	87
Relative Humidity (%)	62.0
Abs. Humidity (lb H2O/1000 lb dry air)	17.9
Fuel Gas Analysis	
NG HHV (Btu/scf)	1159
NG LHV (Btu/scf)	1049
Methane (%V, dry)	81
Ethane (%V, dry)	16.4
Propane (%V, dry)	1.50
n-Hexane (ppmvd)	95.4
Benzene (ppmvd)	98.0
Toluene (ppmvd)	69.2
Ethyl Benzene (ppmvd)	4.0
Xylene (m,p,o) (ppmvd)	25.4
Fd Factor (dscf/MMBtu)	8498

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
98% Load	**Aldehydes**				
Test Period 1	Acetaldehyde (HAP)	NM	--	--	--
	Acrolein (HAP)	NM	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	NM	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	ND	--	--	--
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	ND	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	0.005	9.2E-04	4.0E-03	1.0E-04
	Butane	0.11	1.6E-02	7.0E-02	1.8E-03
	Cyclohexane	ND	--	--	--
	Cyclopentane	ND	--	--	--
	Ethane	14.5	1.1E+00	5.0E+00	1.3E-01
	Ethyl Benzene (HAP)	ND	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	0.003	6.4E-04	2.8E-03	7.2E-05
	Isobutane	NM	--	--	--
	Methane	1005	4.2E+01	1.8E+02	4.7E+00
	Methanol (HAP)	NM	--	--	--
	Methylcyclohexane	ND	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	ND	--	--	--
	n-Pentane	0.01	2.3E-03	1.0E-02	2.6E-04
	Propane	0.97	1.1E-01	4.9E-01	1.2E-02
	Propylene	NM	--	--	--
	Styrene (HAP)	0.002	4.4E-04	1.9E-03	4.9E-05
	Toluene (HAP)	ND	--	--	--
	Xylene (m,p,o) (HAP)	ND	--	--	--
	"Criteria" Pollutants				
	CO	106	7.7	33.8	0.9
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	913	109	479	12.2
	THC	1000	41.7	182	4.7

ND=Non-detect

NM=Not Measured

12/01/95 C3E12T1.WK4

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
98% Load	Semi-Volatile Organics *				
Test Period 1	Acenaphthene	ND	--	--	--
	Acenaphthylene	ND	--	--	--
	Anthracene	ND	--	--	--
	Benz(a)anthracene	ND	--	--	--
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	7.1	8.2E-03	3.6E-02	9.2E-04
	Chysene	ND	--	--	--
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	ND	--	--	--
	Fluorene	0.18	2.1E-04	9.0E-04	2.3E-05
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	ND	--	--	--
	Naphthalene	0.35	4.0E-04	1.8E-03	4.5E-05
	Perylene	ND	--	--	--
	Phenanthrene	ND	--	--	--
	Phenol	1.09	1.3E-03	5.5E-03	1.4E-04
	Pyrene	ND	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 3 - Station 3A Process Conditions
Engine 102
CB LSV-16

Test Date	**06/15/94**
Test Time	**1437-1637**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**2**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	4202
Engine Speed (rpm)	325
Load (%)	101
Fuel Flow (scf/min)	497
Heat Input (MMBtu/hr) (a)	33.7
Heat Rate (Btu/BHP-hr, HHV)	8145
Heat Rate (Btu/BHP-hr, LHV)	7372
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	6947
Vol. Flow (dscfm) - M19, Fd (b)	8678
Stack Gas Temperature (°F)	976
Moisture (%V)	14.1
O2 (%V, dry)	9.4
CO2 (%V, dry)	6.3
Ambient Conditions	
Barometric Pressure (in. Hg)	29.2
Ambient Temperature (°F)	83
Relative Humidity (%)	73.0
Abs. Humidity (lb H2O/1000 lb dry air)	18.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1148
NG LHV (Btu/scf)	1039
Methane (%V, dry)	80
Ethane (%V, dry)	16.8
Propane (%V, dry)	1.60
n-Hexane (ppmvd)	95.4
Benzene (ppmvd)	98.0
Toluene (ppmvd)	69.2
Ethyl Benzene (ppmvd)	4.0
Xylene (m,p,o) (ppmvd)	25.4
Fd Factor (dscf/MMBtu)	8509

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	**Aldehydes**				
Test Period 2	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	16	1.3E+00	5.5E+00	1.4E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	20.1	1.6E+00	7.0E+00	1.7E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1316	5.5E+01	2.4E+02	6.0E+00
	Methanol (HAP)	0.4	3.0E-02	1.5E-01	4.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	111	8.2	35.9	0.9
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	850	103.0	451	11.1
	THC	1002	42.2	185	4.6

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	**Semi-Volatile Organics ***				
Test Period 2	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 3 - Station 3A Process Conditions
Engine 102
CB LSV-16

Test Date	**06/15/94**
Test Time	**1437-1637**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**3**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1957
Pollution Control	None
Engine Operating Conditions	
Brake horsepower (BHP)	3364
Engine Speed (rpm)	302
Load (%)	87
Fuel Flow (scf/min)	412
Heat Input (MMBtu/hr) (a)	28.0
Heat Rate (Btu/BHP-hr, HHV)	8440
Heat Rate (Btu/BHP-hr, LHV)	7639
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	6381
Vol. Flow (dscfm) - M19, Fd (b)	7526
Stack Gas Temperature (°F)	968
Moisture (%V)	11.9
O2 (%V, dry)	9.9
CO2 (%V, dry)	6.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.2
Ambient Temperature (°F)	80
Relative Humidity (%)	87.0
Abs. Humidity (lb H2O/1000 lb dry air)	19.7
Fuel Gas Analysis	
NG HHV (Btu/scf)	1148
NG LHV (Btu/scf)	1039
Methane (%V, dry)	80
Ethane (%V, dry)	16.8
Propane (%V, dry)	1.60
n-Hexane (ppmvd)	95.4
Benzene (ppmvd)	98.0
Toluene (ppmvd)	69.2
Ethyl Benzene (ppmvd)	4.0
Xylene (m,p,o) (ppmvd)	25.4
Fd Factor (dscf/MMBtu)	8509

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
87% Load	**Aldehydes**				
Test Period 3	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	19	1.2E+00	5.4E+00	1.7E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.52	4.0E-02	1.6E-01	5.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	132	8.1	35.4	1.1
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	442	44.4	195	6
	THC	1097	38.3	168	5.2

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 102)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
101% Load	Semi-Volatile Organics *				
Test Period 3	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 3 - Station 3A Process Conditions
Engine 101
CB LSV-16

Test Date	**06/15/94**
Test Time	**1825-1940**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**1**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1955
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	3311
Engine Speed (rpm)	303
Load (%)	85
Fuel Flow (scf/min)	423
Heat Input (MMBtu/hr) (a)	28.7
Heat Rate (Btu/BHP-hr, HHV)	8800
Heat Rate (Btu/BHP-hr, LHV)	7964
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7125
Vol. Flow (dscfm) - M19, Fd (b)	8581
Stack Gas Temperature (°F)	922
Moisture (%V)	12.2
O2 (%V, dry)	11.0
CO2 (%V, dry)	5.5
Ambient Conditions	
Barometric Pressure (in. Hg)	29.6
Ambient Temperature (°F)	84
Relative Humidity (%)	72.0
Abs. Humidity (lb H2O/1000 lb dry air)	18.5
Fuel Gas Analysis	
NG HHV (Btu/scf)	1148
NG LHV (Btu/scf)	1039
Methane (%V, dry)	80
Ethane (%V, dry)	16.8
Propane (%V, dry)	1.60
n-Hexane (ppmvd)	95.4
Benzene (ppmvd)	98.0
Toluene (ppmvd)	69.2
Ethyl Benzene (ppmvd)	4.0
Xylene (m,p,o) (ppmvd)	25.4
Fd Factor (dscf/MMBtu)	8509

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	**Aldehydes**				
Test Period 1	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	19.7	1.3E+00	5.8E+00	1.8E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.5	4.0E-02	1.6E-01	5.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	124	7.8	34.2	1.1
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	154	15.9	69.7	2.2
	THC	1540	55.2	242	7.6

ND=Non-detect
NM=Not Measured

12/06/95 C3E11T1.WK4

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	Semi-Volatile Organics *				
Test Period 1	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 3 - Station 3A Process Conditions
Engine 101
CB LSV-16

Test Date	**06/16/94**
Test Time	**0845-1405**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**2**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1955
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	4056
Engine Speed (rpm)	321
Load (%)	98
Fuel Flow (scf/min)	478
Heat Input (MMBtu/hr) (a)	32.4
Heat Rate (Btu/BHP-hr, HHV)	8118
Heat Rate (Btu/BHP-hr, LHV)	7347
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7195
Vol. Flow (dscfm) - M19, Fd (b)	8421
Stack Gas Temperature (°F)	962
Moisture (%V)	13.5
O2 (%V, dry)	9.5
CO2 (%V, dry)	6.2
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	80
Relative Humidity (%)	78.0
Abs. Humidity (lb H2O/1000 lb dry air)	17.6
Fuel Gas Analysis	
NG HHV (Btu/scf)	1148
NG LHV (Btu/scf)	1039
Methane (%V, dry)	80
Ethane (%V, dry)	16.8
Propane (%V, dry)	1.60
n-Hexane (ppmvd)	54.1
Benzene (ppmvd)	42.4
Toluene (ppmvd)	30.1
Ethyl Benzene (ppmvd)	1.9
Xylene (m,p,o) (ppmvd)	10.7
Fd Factor (dscf/MMBtu)	8509

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
98% Load	**Aldehydes**				
Test Period 2	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	17.1	1.3E+00	5.7E+00	1.5E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	ND	--	--	--
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	ND	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	0.01	2.7E-03	1.2E-02	3.1E-04
	Butane	0.14	2.0E-02	8.7E-02	2.2E-03
	Cyclohexane	ND	--	--	--
	Cyclopentane	ND	--	--	--
	Ethane	19.1	1.5E+00	6.4E+00	1.6E-01
	Ethyl Benzene (HAP)	ND	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	0.001	2.6E-04	1.1E-03	2.9E-05
	Isobutane	NM	--	--	--
	Methane	1210	4.9E+01	2.2E+02	5.5E+00
	Methanol (HAP)	0.47	4.0E-02	1.7E-01	4.0E-03
	Methylcyclohexane	ND	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	ND	--	--	--
	n-Pentane	0.01	1.9E-03	8.3E-03	2.1E-04
	Propane	1.45	1.6E-01	7.1E-01	1.8E-02
	Propylene	NM	--	--	--
	Styrene (HAP)	ND	--	--	--
	Toluene (HAP)	ND	--	--	--
	Xylene (m,p,o) (HAP)	ND	--	--	--
	"Criteria" Pollutants				
	CO	134	9.5	41.5	1.1
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	671	78.2	343	8.7
	THC	1167	47.3	207	5.3

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
98% Load	Semi-Volatile Organics *				
Test Period 2	Acenaphthene	ND	--	--	--
	Acenaphthylene	ND	--	--	--
	Anthracene	ND	--	--	--
	Benz(a)anthracene	ND	--	--	--
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	5.18	5.9E-03	2.5E-02	6.4E-04
	Chysene	ND	--	--	--
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	ND	--	--	--
	Fluorene	0.4	4.5E-04	2.0E-03	5.0E-05
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	ND	--	--	--
	Naphthalene	0.25	2.8E-04	1.2E-03	3.1E-05
	Perylene	ND	--	--	--
	Phenanthrene	ND	--	--	--
	Phenol	0.3	3.4E-04	1.5E-03	3.7E-05
	Pyrene	ND	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 3 - Station 3A Process Conditions
Engine 101
CB LSV-16

Test Date	**06/16/94**
Test Time	**1405-1806**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**3**
Unit Description	
Engine Type	4-Stroke, LB, TC
Rated BHP	4200
Rated RPM	330
Year Installed	1955
Pollution Control	None
Engine Operating Conditions	
Brake horespower (BHP)	4117
Engine Speed (rpm)	325
Load (%)	99
Fuel Flow (scf/min)	486
Heat Input (MMBtu/hr) (a)	33.0
Heat Rate (Btu/BHP-hr, HHV)	8126
Heat Rate (Btu/BHP-hr, LHV)	7355
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	7319
Vol. Flow (dscfm) - M19, Fd (b)	8409
Stack Gas Temperature (°F)	970
Moisture (%V)	13.5
O2 (%V, dry)	9.3
CO2 (%V, dry)	6.1
Ambient Conditions	
Barometric Pressure (in. Hg)	29.2
Ambient Temperature (°F)	89
Relative Humidity (%)	58.0
Abs. Humidity (lb H2O/1000 lb dry air)	17.9
Fuel Gas Analysis	
NG HHV (Btu/scf)	1148
NG LHV (Btu/scf)	1039
Methane (%V, dry)	80
Ethane (%V, dry)	16.8
Propane (%V, dry)	1.60
n-Hexane (ppmvd)	54.1
Benzene (ppmvd)	42.4
Toluene (ppmvd)	30.1
Ethyl Benzene (ppmvd)	1.9
Xylene (m,p,o) (ppmvd)	10.7
Fd Factor (dscf/MMBtu)	8509

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
99% Load	**Aldehydes**				
Test Period 3	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	15.8	1.2E+00	5.4E+00	1.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	19.4	1.5E+00	6.6E+00	1.7E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	1243	5.1E+01	2.2E+02	5.6E+00
	Methanol (HAP)	0.41	3.0E-02	1.5E-01	4.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	131	9.4	41.3	1.0
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	785	93.0	407	10.2
	THC	1105	45.5	199	5.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 3 - Station 3A
CB LSV-16 (Engine 101)

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
99% Load	Semi-Volatile Organics *				
Test Period 3	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 9
I-R KVS 412

Test Date	**8/28/94**
Test Time	**1254-1520**
Load Condition	**Intermediate**
Sampling Location	**Before SCR**
Test Period	**13**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	SCR
Engine Operating Conditions	
Brake horsepower (BHP)	1764
Engine Speed (rpm)	330
Load (%)	88
Fuel Flow (scf/min)	261
Heat Input (MMBtu/hr) (a)	15.6
Heat Rate (Btu/BHP-hr, HHV)	8950
Heat Rate (Btu/BHP-hr, LHV)	8068
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4181
Vol. Flow (dscfm) - M19, Fd (b)	3656
Stack Gas Temperature (°F)	779
Moisture (%V)	14.4
O2 (%V, dry)	8.3
CO2 (%V, dry)	7.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	94
Relative Humidity (%)	27.8
Abs. Humidity (lb H2O/1000 lb dry air)	10.1
Fuel Gas Analysis	
NG HHV (Btu/scf)	1010
NG LHV (Btu/scf)	910
Methane (%V, dry)	93
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.45
n-Hexane (ppmvd)	68.0
Benzene (ppmvd)	10.9
Toluene (ppmvd)	14.7
Ethyl Benzene (ppmvd)	0.9
Xylene (m,p,o) (ppmvd)	4.4
Fd Factor (dscf/MMBtu)	8522

a Based on HHV
b Used in emission calculations.
NM - Not measured.

11/17/95 C4E9T13.WK4

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period 13	Acetaldehyde (HAP)	NM	--	--	--
	Acrolein (HAP)	NM	--	--	--
	Butyr/Isobutyraldehyde	0.005	4.1E-04	1.8E-03	1.1E-04
	Formaldehyde (HAP)	NM	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	ND	--	--	--
	1,2,4-Trimethylbenzene	0.002	2.4E-04	1.0E-03	6.2E-05
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	0.004	5.2E-04	2.3E-03	1.3E-04
	2,2,4-Trimethylpentane (HAP)	0.04	5.3E-03	2.3E-02	1.4E-03
	Acetylene	NM	--	--	--
	Benzene (HAP)	0.06	5.4E-03	2.3E-02	1.4E-03
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	0.05	4.4E-03	1.9E-02	1.1E-03
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	0.007	8.7E-04	3.8E-03	2.2E-04
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	0.36	3.6E-02	1.6E-01	9.4E-03
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	NM	--	--	--
	Methylcyclohexane	0.21	2.4E-02	1.1E-01	6.3E-03
	n-Nonane	0.01	2.0E-03	8.6E-03	5.0E-04
	n-Octane	0.05	6.7E-03	2.9E-02	1.7E-03
	n-Pentane	1.0	8.6E-02	3.8E-01	2.2E-02
	Propane	25.0	1.3E+00	5.7E+00	3.4E-01
	Propylene	NM	--	--	--
	Styrene (HAP)	ND	--	--	--
	Toluene (HAP)	0.08	8.3E-03	3.6E-02	2.1E-03
	Xylene (m,p,o) (HAP)	0.02	2.6E-03	1.1E-02	6.7E-04
	"Criteria" Pollutants				
	CO	64.3	2.2	9.6	0.6
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	1566	87.7	384	22.6
	THC	517	10.1	44.1	2.6

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	Semi-Volatile Organics *				
Test Period 13	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 9
I-R KVS 412

Test Date	**8/29/94**
Test Time	**0858-0932**
Load Condition	**Full**
Sampling Location	**Before SCR**
Test Period	**14**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	SCR
Engine Operating Conditions	
Brake horespower (BHP)	1840
Engine Speed (rpm)	332
Load (%)	91
Fuel Flow (scf/min)	272
Heat Input (MMBtu/hr) (a)	16.3
Heat Rate (Btu/BHP-hr, HHV)	8978
Heat Rate (Btu/BHP-hr, LHV)	8090
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4259
Vol. Flow (dscfm) - M19, Fd (b)	3914
Stack Gas Temperature (°F)	779
Moisture (%V)	14.4
O2 (%V, dry)	8.6
CO2 (%V, dry)	6.9
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	77
Relative Humidity (%)	52.1
Abs. Humidity (lb H2O/1000 lb dry air)	10.6
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV
b Used in emission calculations.
NM - Not measured.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	**Aldehydes**				
Test Period 14	Acetaldehyde (HAP)	NM	--	--	--
	Acrolein (HAP)	NM	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	NM	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	NM	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	67.6	2.4	10.6	0.6
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	1454	85.2	373	21.0
	THC	524	10.7	46.8	2.6

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	Semi-Volatile Organics *				
Test Period 14	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 9
I-R KVS 412

Test Date	**8/29/94**
Test Time	**1613-1700**
Load Condition	**Full**
Sampling Location	**Before SCR**
Test Period	**17**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	SCR
Engine Operating Conditions	
Brake horespower (BHP)	1830
Engine Speed (rpm)	331
Load (%)	91
Fuel Flow (scf/min)	266
Heat Input (MMBtu/hr) (a)	15.9
Heat Rate (Btu/BHP-hr, HHV)	8821
Heat Rate (Btu/BHP-hr, LHV)	7948
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4259
Vol. Flow (dscfm) - M19, Fd (b)	3754
Stack Gas Temperature (°F)	779
Moisture (%V)	14.4
O2 (%V, dry)	8.3
CO2 (%V, dry)	7.1
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	91
Relative Humidity (%)	31.7
Abs. Humidity (lb H2O/1000 lb dry air)	10.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1011
NG LHV (Btu/scf)	911
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

NM - Not measured.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	**Aldehydes**				
Test Period 17	Acetaldehyde (HAP)	1.2	6.0E-02	2.8E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	4.7	1.8E-01	7.7E-01	4.0E-02
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.5	2.0E-02	9.0E-02	5.0E-03
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	59.1	2.1	9.0	0.5
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	1567	89.7	393	22.3
	THC	493	9.8	43.0	2.4

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
91% Load	Semi-Volatile Organics *				
Test Period 17	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

4-Stroke Clean-Burn

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/27/94**
Test Time	**1108-1503**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**11**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horsepower (BHP)	1783
Engine Speed (rpm)	330
Load (%)	89
Fuel Flow (scf/min)	272
Heat Input (MMBtu/hr) (a)	16.2
Heat Rate (Btu/BHP-hr, HHV)	9239
Heat Rate (Btu/BHP-hr, LHV)	8327
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	5726
Vol. Flow (dscfm) - M19, Fd (b)	4975
Stack Gas Temperature (°F)	741
Moisture (%V)	11.1
O2 (%V, dry)	11.3
CO2 (%V, dry)	5.4
Ambient Conditions	
Barometric Pressure (in. Hg)	29.5
Ambient Temperature (°F)	91
Relative Humidity (%)	32.7
Abs. Humidity (lb H2O/1000 lb dry air)	10.8
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	94
Ethane (%V, dry)	2.5
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	61.3
Benzene (ppmvd)	9.6
Toluene (ppmvd)	11.2
Ethyl Benzene (ppmvd)	0.6
Xylene (m,p,o) (ppmvd)	3.1
Fd Factor (dscf/MMBtu)	8470

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
89% Load	**Aldehydes**				
Test Period 11	Acetaldehyde (HAP)	2.5	1.4E-01	6.0E-01	4.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.01	1.1E-03	4.8E-03	2.8E-04
	Formaldehyde (HAP)	20.5	7.8E-01	3.4E+00	2.0E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	37.1	1.4E+00	6.1E+00	3.6E-01
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	0.9	4.0E-02	1.6E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	216	7.6	33.4	1.9
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	42.8	2.5	10.9	0.6
	THC	1336	27.0	118	6.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
89% Load	Semi-Volatile Organics *				
Test Period 11	Acenaphthene	0.001	6.5E-07	2.8E-06	1.6E-07
	Acenaphthylene	0.004	2.6E-06	1.1E-05	6.5E-07
	Anthracene	0.0006	3.9E-07	1.7E-06	9.9E-08
	Benz(a)anthracene	0.0002	1.3E-07	5.8E-07	3.4E-08
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	0.0002	1.4E-07	6.1E-07	3.5E-08
	Benzo(b)fluoranthene	0.00009	5.8E-08	2.6E-07	1.5E-08
	Benzo(g,h,i)perylene	0.0002	1.2E-07	5.5E-07	3.2E-08
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	0.0005	3.1E-07	1.4E-06	7.9E-08
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.0008	5.3E-07	2.3E-06	1.3E-07
	Fluorene	0.002	1.2E-06	5.2E-06	3.0E-07
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	0.025	1.7E-05	7.3E-05	4.2E-06
	Naphthalene	0.1	6.7E-05	2.9E-04	1.7E-05
	Perylene	ND	--	--	--
	Phenanthrene	0.006	3.7E-06	1.6E-05	9.4E-07
	Phenol	NM	--	--	--
	Pyrene	0.001	6.9E-07	3.0E-06	1.7E-07

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

12/01/95

C4E8T11.WK4

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/27/94**
Test Time	**1639-1921**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Test Period	**12**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horespower (BHP)	1640
Engine Speed (rpm)	330
Load (%)	82
Fuel Flow (scf/min)	253
Heat Input (MMBtu/hr) (a)	15.1
Heat Rate (Btu/BHP-hr, HHV)	9340
Heat Rate (Btu/BHP-hr, LHV)	8418
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	5737
Vol. Flow (dscfm) - M19, Fd (b)	4706
Stack Gas Temperature (°F)	719
Moisture (%V)	11.1
O2 (%V, dry)	11.4
CO2 (%V, dry)	5.2
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	86
Relative Humidity (%)	35.0
Abs. Humidity (lb H2O/1000 lb dry air)	9.7
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	94
Ethane (%V, dry)	2.5
Propane (%V, dry)	0.41
n-Hexane (ppmvd)	61.3
Benzene (ppmvd)	9.6
Toluene (ppmvd)	11.2
Ethyl Benzene (ppmvd)	0.6
Xylene (m,p,o) (ppmvd)	3.1
Fd Factor (dscf/MMBtu)	8470

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
82% Load	**Aldehydes**				
Test Period 12	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.06	3.2E-03	1.4E-02	8.8E-04
	Formaldehyde (HAP)	28.4	1.0E+00	4.4E+00	2.8E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	ND	--	--	--
	1,2,4-Trimethylbenzene	0.001	1.6E-04	7.1E-04	4.2E-05
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	0.01	1.7E-03	7.5E-03	4.3E-04
	Acetylene	NM	--	--	--
	Benzene (HAP)	0.03	2.8E-03	1.2E-02	7.1E-04
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	0.02	1.3E-03	5.9E-03	3.4E-04
	Ethane	66.2	2.3E+00	1.0E+01	6.5E-01
	Ethyl Benzene (HAP)	0.002	2.9E-04	1.3E-03	7.3E-05
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	0.1	1.0E-02	4.6E-02	2.6E-03
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.4	5.0E-02	2.4E-01	2.0E-02
	Methylcyclohexane	0.05	6.2E-03	2.7E-02	1.6E-03
	n-Nonane	0.004	6.8E-04	3.0E-03	1.7E-04
	n-Octane	0.01	2.0E-03	8.7E-03	5.0E-04
	n-Pentane	0.28	2.5E-02	1.1E-01	6.3E-03
	Propane	6.76	3.7E-01	1.6E+00	9.3E-02
	Propylene	NM	--	--	--
	Styrene (HAP)	ND	--	--	--
	Toluene (HAP)	0.02	2.7E-03	1.2E-02	6.9E-04
	Xylene (m.p.o) (HAP)	0.008	9.9E-04	4.4E-03	2.5E-04
	"Criteria" Pollutants				
	CO	240	7.9	34.6	2.2
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	36.6	2.0	8.7	0.6
	THC	2308	43.4	190	12.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
82% Load	Semi-Volatile Organics *				
Test Period 12	Acenaphthene	0.09	6.3E-07	2.7E-06	1.6E-07
	Acenaphthylene	0.4	2.5E-06	1.1E-05	6.4E-07
	Anthracene	0.06	3.8E-07	1.7E-06	9.6E-08
	Benz(a)anthracene	0.02	1.3E-07	5.6E-07	3.3E-08
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	0.02	1.3E-07	5.9E-07	3.4E-08
	Benzo(b)fluoranthene	0.008	5.7E-08	2.5E-07	1.4E-08
	Benzo(g,h,i)perylene	0.02	1.2E-07	5.3E-07	3.1E-08
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	0.05	3.0E-07	1.3E-06	7.7E-08
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	0.08	5.1E-07	2.2E-06	1.3E-07
	Fluorene	0.2	1.1E-06	5.0E-06	2.9E-07
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	2.4	1.6E-05	7.1E-05	4.1E-06
	Naphthalene	9.7	6.5E-05	2.9E-04	1.7E-05
	Perylene	ND	--	--	--
	Phenanthrene	0.5	3.6E-06	1.6E-05	9.1E-07
	Phenol	NM	--	--	--
	Pyrene	0.1	6.7E-07	2.9E-06	1.7E-07

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**0745-0815**
Load Condition	**8°**
Sampling Location	**Exhaust**
Test Period	**A**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horsespower (BHP)	1846
Engine Speed (rpm)	330
Load (%)	92
Fuel Flow (scf/min)	267
Heat Input (MMBtu/hr) (a)	15.9
Heat Rate (Btu/BHP-hr, HHV)	8757
Heat Rate (Btu/BHP-hr, LHV)	7893
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4531
Vol. Flow (dscfm) - M19, Fd (b)	4927
Stack Gas Temperature (°F)	746
Moisture (%V)	12.0
O2 (%V, dry)	11.3
CO2 (%V, dry)	5.2
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	73
Relative Humidity (%)	66.4
Abs. Humidity (lb H2O/1000 lb dry air)	11.7
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	**Aldehydes**				
Test Period A	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.0	7.0E-02	3.1E-01	2.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	25.5	9.5E-01	4.2E+00	2.3E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.3	5.0E-02	2.2E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	232	8.1	35.5	2.0
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	39.7	2.3	10.0	0.6
	THC	1631	32.5	142	8.0

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
92% Load	Semi-Volatile Organics *				
Test Period A	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**0903-0944**
Load Condition	**8°**
Sampling Location	**Exhaust**
Test Period	**B**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horespower (BHP)	1693
Engine Speed (rpm)	329
Load (%)	85
Fuel Flow (scf/min)	265
Heat Input (MMBtu/hr) (a)	15.8
Heat Rate (Btu/BHP-hr, HHV)	9477
Heat Rate (Btu/BHP-hr, LHV)	8542
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4572
Vol. Flow (dscfm) - M19, Fd (b)	4978
Stack Gas Temperature (°F)	739
Moisture (%V)	11.8
O2 (%V, dry)	11.5
CO2 (%V, dry)	5.1
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	78
Relative Humidity (%)	55.5
Abs. Humidity (lb H2O/1000 lb dry air)	11.6
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	**Aldehydes**				
Test Period B	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.2	8.0E-02	3.5E-01	2.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	31	1.2E+00	5.0E+00	3.1E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.5	6.0E-02	2.7E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	263	9.1	39.8	2.4
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	33.4	1.9	8.3	0.5
	THC	2534	50.2	220	13.4

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
85% Load	Semi-Volatile Organics *				
Test Period B	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**1013-1042**
Load Condition	**5°**
Sampling Location	**Exhaust**
Test Period	**C**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horespower (BHP)	1656
Engine Speed (rpm)	327
Load (%)	84
Fuel Flow (scf/min)	276
Heat Input (MMBtu/hr) (a)	16.5
Heat Rate (Btu/BHP-hr, HHV)	10094
Heat Rate (Btu/BHP-hr, LHV)	9098
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4553
Vol. Flow (dscfm) - M19, Fd (b)	5229
Stack Gas Temperature (°F)	756
Moisture (%V)	11.7
O2 (%V, dry)	11.6
CO2 (%V, dry)	5.0
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	82
Relative Humidity (%)	47.0
Abs. Humidity (lb H2O/1000 lb dry air)	11.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
84% Load	**Aldehydes**				
Test Period C	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.1	8.0E-02	3.3E-01	2.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	31	1.2E+00	5.2E+00	3.2E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.6	7.0E-02	2.9E-01	2.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	230	8.3	36.3	2.3
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	30.8	1.8	8.0	0.5
	THC	2964	61.1	268	16.7

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
84% Load	Semi-Volatile Organics *				
Test Period C	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**1100-1137**
Load Condition	**5°**
Sampling Location	**Exhaust**
Test Period	**D**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horespower (BHP)	1708
Engine Speed (rpm)	323
Load (%)	88
Fuel Flow (scf/min)	277
Heat Input (MMBtu/hr) (a)	16.5
Heat Rate (Btu/BHP-hr, HHV)	9819
Heat Rate (Btu/BHP-hr, LHV)	8850
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4518
Vol. Flow (dscfm) - M19, Fd (b)	5143
Stack Gas Temperature (°F)	766
Moisture (%V)	11.8
O2 (%V, dry)	11.4
CO2 (%V, dry)	5.1
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	85
Relative Humidity (%)	43.2
Abs. Humidity (lb H2O/1000 lb dry air)	11.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period D	Acetaldehyde (HAP)	ND	–	–	–
	Acrolein (HAP)	1.2	8.0E-02	3.7E-01	2.0E-02
	Butyr/Isobutyraldehyde	NM	–	–	–
	Formaldehyde (HAP)	26.7	1.0E+00	4.5E+00	2.7E-01
	Propionaldehyde (HAP)	NM	–	–	–
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	–	–	–
	1,2,4-Trimethylbenzene	NM	–	–	–
	1,3-Butadiene (HAP)	NM	–	–	–
	1,3,5-Trimethylbenzene	NM	–	–	–
	2,2,4-Trimethylpentane (HAP)	NM	–	–	–
	Acetylene	NM	–	–	–
	Benzene (HAP)	NM	–	–	–
	Butane	NM	–	–	–
	Cyclohexane	NM	–	–	–
	Cyclopentane	NM	–	–	–
	Ethane	NM	–	–	–
	Ethyl Benzene (HAP)	NM	–	–	–
	Ethylene	NM	–	–	–
	n-Hexane (HAP)	NM	–	–	–
	Isobutane	NM	–	–	–
	Methane	NM	–	–	–
	Methanol (HAP)	1.4	6.0E-02	2.5E-01	2.0E-02
	Methylcyclohexane	NM	–	–	–
	n-Nonane	NM	–	–	–
	n-Octane	NM	–	–	–
	n-Pentane	NM	–	–	–
	Propane	NM	–	–	–
	Propylene	NM	–	–	–
	Styrene (HAP)	NM	–	–	–
	Toluene (HAP)	NM	–	–	–
	Xylene (m,p,o) (HAP)	NM	–	–	–
	"Criteria" Pollutants				
	CO	205	7.4	32.5	2.0
	NMHC	NM	–	–	–
	NMEHC	NM	–	–	–
	NOx	34.5	2.1	9	0.5
	THC	2033	42.1	184	11.2

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Semi-Volatile Organics** *				
Test Period D	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**1150-1228**
Load Condition	**8°**
Sampling Location	**Exhaust**
Test Period	**E**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horespower (BHP)	1783
Engine Speed (rpm)	335
Load (%)	88
Fuel Flow (scf/min)	276
Heat Input (MMBtu/hr) (a)	16.5
Heat Rate (Btu/BHP-hr, HHV)	9375
Heat Rate (Btu/BHP-hr, LHV)	8450
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4517
Vol. Flow (dscfm) - M19, Fd (b)	5040
Stack Gas Temperature (°F)	762
Moisture (%V)	11.9
O2 (%V, dry)	11.2
CO2 (%V, dry)	5.2
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	86
Relative Humidity (%)	40.7
Abs. Humidity (lb H2O/1000 lb dry air)	11.3
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	**Aldehydes**				
Test Period E	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.4	1.0E-01	4.4E-01	3.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	28	1.1E+00	4.7E+00	2.7E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.4	6.0E-02	2.5E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	240	8.7	37.9	2.2
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	36.5	2.2	9.5	0.6
	THC	1854	38.2	167	9.7

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
88% Load	Semi-Volatile Organics *				
Test Period E	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**1234-1251**
Load Condition	**11°**
Sampling Location	**Exhaust**
Test Period	**F**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horsepower (BHP)	1687
Engine Speed (rpm)	333
Load (%)	87
Fuel Flow (scf/min)	254
Heat Input (MMBtu/hr) (a)	15.1
Heat Rate (Btu/BHP-hr, HHV)	9116
Heat Rate (Btu/BHP-hr, LHV)	8216
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4517
Vol. Flow (dscfm) - M19, Fd (b)	4582
Stack Gas Temperature (°F)	749
Moisture (%V)	12.1
O2 (%V, dry)	11.1
CO2 (%V, dry)	5.3
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	89
Relative Humidity (%)	37.8
Abs. Humidity (lb H2O/1000 lb dry air)	11.6
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
87% Load	**Aldehydes**				
Test Period F	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.4	9.0E-02	4.0E-01	2.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	26.7	9.5E-01	4.2E+00	2.6E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.3	5.0E-02	2.1E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	240	8.0	34.9	2.1
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	40.3	2.2	9.6	0.6
	THC	1317	25.0	109	6.7

ND=Non-detect
NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
87% Load	**Semi-Volatile Organics ***				
Test Period F	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 4 - Process Conditions
Engine 8
I-R KVS 412

Test Date	**8/30/94**
Test Time	**1307-1339**
Load Condition	**11°**
Sampling Location	**Exhaust**
Test Period	**G**
Unit Description	
Engine Type	4-Stroke, TC
Rated BHP	2000
Rated RPM	330
Year Installed	1956
Pollution Control	PCC
Engine Operating Conditions	
Brake horsepower (BHP)	1621
Engine Speed (rpm)	333
Load (%)	80
Fuel Flow (scf/min)	247
Heat Input (MMBtu/hr) (a)	14.7
Heat Rate (Btu/BHP-hr, HHV)	9226
Heat Rate (Btu/BHP-hr, LHV)	8315
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	4579
Vol. Flow (dscfm) - M19, Fd (b)	4567
Stack Gas Temperature (°F)	733
Moisture (%V)	11.8
O2 (%V, dry)	11.3
CO2 (%V, dry)	5.1
Ambient Conditions	
Barometric Pressure (in. Hg)	29.4
Ambient Temperature (°F)	90
Relative Humidity (%)	36.4
Abs. Humidity (lb H2O/1000 lb dry air)	11.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Methane (%V, dry)	96
Ethane (%V, dry)	2.7
Propane (%V, dry)	0.46
n-Hexane (ppmvd)	60.9
Benzene (ppmvd)	9.1
Toluene (ppmvd)	14.0
Ethyl Benzene (ppmvd)	1.5
Xylene (m,p,o) (ppmvd)	3.5
Fd Factor (dscf/MMBtu)	8518

a Based on HHV

b Used in emission calculations.

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
80% Load	**Aldehydes**				
Test Period G	Acetaldehyde (HAP)	ND	--	--	--
	Acrolein (HAP)	1.5	1.0E-01	4.2E-01	3.0E-02
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	31	1.1E+00	4.7E+00	3.0E-01
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane(HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	NM	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	NM	--	--	--
	Methanol (HAP)	1.4	5.0E-02	2.3E-01	1.0E-02
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	278	9.0	39.3	2.5
	NMHC	NM	--	--	--
	NMEHC	NM	--	--	--
	NOx	34.0	1.8	7.9	0.5
	THC	2305	42.5	186	11.9

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 4
I-R KVS 412

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
80% Load	Semi-Volatile Organics *				
Test Period G	Acenaphthene	NM	–	–	–
	Acenaphthylene	NM	–	–	–
	Anthracene	NM	–	–	–
	Benz(a)anthracene	NM	–	–	–
	Benzo(a)pyrene	NM	–	–	–
	Benzo(e)pyrene	NM	–	–	–
	Benzo(b)fluoranthene	NM	–	–	–
	Benzo(g,h,i)perylene	NM	–	–	–
	Benzo(k)fluoroanthene	NM	–	–	–
	Biphenyl	NM	–	–	–
	Chysene	NM	–	–	–
	Dibenz(a,h)anthracene	NM	–	–	–
	Fluoranthene	NM	–	–	–
	Fluorene	NM	–	–	–
	Indeno(1,2,3-c,d)pyrene	NM	–	–	–
	2-Methylnaphthalene	NM	–	–	–
	Naphthalene	NM	–	–	–
	Perylene	NM	–	–	–
	Phenanthrene	NM	–	–	–
	Phenol	NM	–	–	–
	Pyrene	NM	–	–	–

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

Gas Turbine

GRI Campaign 6 - Station 6B CEM Results
Turbine
Solar Taurus

Test Date	**11/07/94**
Test Time	**1709-1823**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**6**
Unit Description	
Turbine Type	Gas Turbine
Rated BHP	5419
Year Installed	1993
Pollution Control	None
Turbine Operating Conditions	
Brake horespower (BHP)	4803
Power Turbine Speed (rpm)	12458
Load (%)	95
T5 Temperature (°F)	1401
Compressor Suction (psig)	464
Compressor Discharge (psig)	645
Suction Temperature (°F)	76.5
Discharge Temperature (°F)	130
Fuel Flow (scf/min)	709
Heat Input (MMBtu/hr) (a)	42.8
Heat Rate (Btu/BHP-hr, HHV)	9040
Heat Rate (Btu/BHP-hr, LHV)	8187
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	29192
Vol. Flow (dscfm) - M19, Fd (b)	25757
Stack Gas Temperature (°F)	954
Moisture (%V)	6.4
O2 (%V, dry)	16.0
CO2 (%V, dry)	3.2
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	69
Relative Humidity (%)	44.2
Abs. Humidity (lb H2O/1000 lb dry air)	7.5
Fuel Gas Analysis	
NG HHV (Btu/scf)	1020
NG LHV (Btu/scf)	924
Methane (%V, dry)	94
Ethane (%V, dry)	3.00
Propane (%V, dry)	0.33
n-Hexane (ppmvd)	NM
Benzene (ppmvd)	NM
Toluene (ppmvd)	NM
Ethyl Benzene (ppmvd)	NM
Xylene (m,p,o) (ppmvd)	NM
Fd Factor (dscf/MMBtu)	8437

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	Emission Rate (tons/yr)	Emission Rate (g/BHP-hr)
95% Load	**Aldehydes**				
Test Period 6	Acetaldehyde (HAP)	1.48	2.2E-01	9.5E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.02	4.0E-03	1.8E-02	3.8E-04
	Formaldehyde (HAP)	ND	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	ND	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	ND	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	ND	--	--	--
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	86.5	13.2	57.8	1.2
	THC	ND	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	Semi-Volatile Organics *				
Test Period 6	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6B CEM Results
Turbine
Solar Taurus

Test Date	**11/08/94**
Test Time	**0915-1344**
Load Condition	**Full**
Sampling Location	**Exhaust**
Test Period	**7**
Unit Description	
Turbine Type	Gas Turbine
Rated BHP	5419
Year Installed	1993
Pollution Control	None
Turbine Operating Conditions	
Brake horsepower (BHP)	4709
Power Turbine Speed (rpm)	12250
Load (%)	95
T5 Temperature (°F)	1400
Compressor Suction (psig)	478
Compressor Discharge (psig)	658
Suction Temperature (°F)	76.8
Discharge Temperature (°F)	129
Fuel Flow (scf/min)	745
Heat Input (MMBtu/hr) (a)	45.0
Heat Rate (Btu/BHP-hr, HHV)	9691
Heat Rate (Btu/BHP-hr, LHV)	8781
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	30964
Vol. Flow (dscfm) - M19, Fd (b)	26581
Stack Gas Temperature (°F)	941
Moisture (%V)	6.5
O2 (%V, dry)	15.9
CO2 (%V, dry)	3.2
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	76
Relative Humidity (%)	47.2
Abs. Humidity (lb H2O/1000 lb dry air)	10.4
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	93
Ethane (%V, dry)	3.43
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	NM
Benzene (ppmvd)	NM
Toluene (ppmvd)	NM
Ethyl Benzene (ppmvd)	NM
Xylene (m,p,o) (ppmvd)	NM
Fd Factor (dscf/MMBtu)	8436

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	**Aldehydes**				
Test Period 7	Acetaldehyde (HAP)	1.23	1.9E-01	8.3E-01	2.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	NM	--	--	--
	Formaldehyde (HAP)	ND	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	NM	--	--	--
	1,2,4-Trimethylbenzene	NM	--	--	--
	1,3-Butadiene (HAP)	NM	--	--	--
	1,3,5-Trimethylbenzene	NM	--	--	--
	2,2,4-Trimethylpentane (HAP)	NM	--	--	--
	Acetylene	NM	--	--	--
	Benzene (HAP)	NM	--	--	--
	Butane	NM	--	--	--
	Cyclohexane	NM	--	--	--
	Cyclopentane	NM	--	--	--
	Ethane	ND	--	--	--
	Ethyl Benzene (HAP)	NM	--	--	--
	Ethylene	NM	--	--	--
	n-Hexane (HAP)	NM	--	--	--
	Isobutane	NM	--	--	--
	Methane	ND	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	NM	--	--	--
	n-Nonane	NM	--	--	--
	n-Octane	NM	--	--	--
	n-Pentane	NM	--	--	--
	Propane	NM	--	--	--
	Propylene	NM	--	--	--
	Styrene (HAP)	NM	--	--	--
	Toluene (HAP)	NM	--	--	--
	Xylene (m,p,o) (HAP)	NM	--	--	--
	"Criteria" Pollutants				
	CO	ND	--	--	--
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	84.1	13.5	59.0	1.3
	THC	ND	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
95% Load	**Semi-Volatile Organics ***				
Test Period 7	Acenaphthene	ND	--	--	--
	Acenaphthylene	ND	--	--	--
	Anthracene	ND	--	--	--
	Benz(a)anthracene	ND	--	--	--
	Benzo(a)pyrene	ND	--	--	--
	Benzo(e)pyrene	ND	--	--	--
	Benzo(b)fluoranthene	ND	--	--	--
	Benzo(g,h,i)perylene	ND	--	--	--
	Benzo(k)fluoroanthene	ND	--	--	--
	Biphenyl	0.30	1.1E-03	4.7E-03	1.0E-04
	Chysene	0.003	9.8E-06	4.3E-05	9.5E-07
	Dibenz(a,h)anthracene	ND	--	--	--
	Fluoranthene	ND	--	--	--
	Fluorene	ND	--	--	--
	Indeno(1,2,3-c,d)pyrene	ND	--	--	--
	2-Methylnaphthalene	ND	--	--	--
	Naphthalene	0.01	4.7E-05	2.1E-04	4.6E-06
	Perylene	ND	--	--	--
	Phenanthrene	ND	--	--	--
	Phenol	0.04	1.5E-04	6.6E-04	1.5E-05
	Pyrene	ND	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

GRI Campaign 6 - Station 6B CEM Results
Turbine
Solar Taurus

Test Date	**11/08/94**
Test Time	**1700-1912**
Load Condition	**Low**
Sampling Location	**Exhaust**
Test Period	**8**
Unit Description	
Turbine Type	Gas Turbine
Rated BHP	5419
Year Installed	1993
Pollution Control	None
Turbine Operating Conditions	
Brake horespower (BHP)	3934
Power Turbine Speed (rpm)	11567
Load (%)	77
T5 Temperature (°F)	1305
Compressor Suction (psig)	472
Compressor Discharge (psig)	627
Suction Temperature (°F)	79.1
Discharge Temperature (°F)	125
Fuel Flow (scf/min)	601
Heat Input (MMBtu/hr) (a)	36.2
Heat Rate (Btu/BHP-hr, HHV)	9355
Heat Rate (Btu/BHP-hr, LHV)	8475
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	27544
Vol. Flow (dscfm) - M19, Fd (b)	23311
Stack Gas Temperature (°F)	902
Moisture (%V)	6.1
O2 (%V, dry)	16.3
CO2 (%V, dry)	2.9
Ambient Conditions	
Barometric Pressure (in. Hg)	26.5
Ambient Temperature (°F)	67
Relative Humidity (%)	45.6
Abs. Humidity (lb H2O/1000 lb dry air)	7.2
Fuel Gas Analysis	
NG HHV (Btu/scf)	1021
NG LHV (Btu/scf)	925
Methane (%V, dry)	93
Ethane (%V, dry)	3.43
Propane (%V, dry)	0.30
n-Hexane (ppmvd)	NM
Benzene (ppmvd)	NM
Toluene (ppmvd)	NM
Ethyl Benzene (ppmvd)	NM
Xylene (m,p,o) (ppmvd)	NM
Fd Factor (dscf/MMBtu)	8436

a Based on HHV
b Used in emission calculations.

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ppmvd @15%O2)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
77% Load	**Aldehydes**				
Test Period 8	Acetaldehyde (HAP)	1.91	2.4E-01	1.0E+00	3.0E-02
	Acrolein (HAP)	ND	--	--	--
	Butyr/Isobutyraldehyde	0.10	2.0E-02	8.6E-02	2.3E-03
	Formaldehyde (HAP)	ND	--	--	--
	Propionaldehyde (HAP)	NM	--	--	--
	Volatile Organics				
	1,2,3-Trimethylbenzene	ND	--	--	--
	1,2,4-Trimethylbenzene	ND	--	--	--
	1,3-Butadiene (HAP)	ND	--	--	--
	1,3,5-Trimethylbenzene	ND	--	--	--
	2,2,4-Trimethylpentane (HAP)	0.003	8.3E-04	3.6E-03	9.5E-05
	Acetylene	ND	--	--	--
	Benzene (HAP)	0.008	1.7E-03	7.4E-03	2.0E-04
	Butane	0.28	4.5E-02	2.0E-01	5.2E-03
	Cyclohexane	0.01	3.4E-03	1.5E-02	3.9E-04
	Cyclopentane	0.005	9.7E-04	4.2E-03	1.1E-04
	Ethane	ND	--	--	--
	Ethyl Benzene (HAP)	ND	--	--	--
	Ethylene	ND	--	--	--
	n-Hexane (HAP)	0.05	1.3E-02	5.7E-02	1.5E-03
	Isobutane	0.25	4.2E-02	1.8E-01	4.8E-03
	Methane	ND	--	--	--
	Methanol (HAP)	ND	--	--	--
	Methylcyclohexane	0.01	3.9E-03	1.7E-02	4.5E-04
	n-Nonane	ND	--	--	--
	n-Octane	0.002	7.0E-04	3.1E-03	8.1E-05
	n-Pentane	0.10	2.0E-02	8.7E-02	2.3E-03
	Propane	2.04	2.5E-01	1.1E+00	2.9E-02
	Propylene	ND	--	--	--
	Styrene (HAP)	ND	--	--	--
	Toluene (HAP)	0.007	1.8E-03	8.1E-03	2.1E-04
	Xylene (m,p,o) (HAP)	ND	--	--	--
	"Criteria" Pollutants				
	CO	ND	--	--	--
	NMHC	ND	--	--	--
	NMEHC	ND	--	--	--
	NOx	72.3	9.3	40.9	1.1
	THC	ND	--	--	--

ND=Non-detect

NM=Not Measured

Emission Summary
GRI Campaign 6 - Station 6B
Turbine
Solar Taurus

Test Condition	Pollutant	Concentration (ug/dscf)	Emission Rate (lb/hr)	(tons/yr)	(g/BHP-hr)
77% Load	Semi-Volatile Organics *				
Test Period 8	Acenaphthene	NM	--	--	--
	Acenaphthylene	NM	--	--	--
	Anthracene	NM	--	--	--
	Benz(a)anthracene	NM	--	--	--
	Benzo(a)pyrene	NM	--	--	--
	Benzo(e)pyrene	NM	--	--	--
	Benzo(b)fluoranthene	NM	--	--	--
	Benzo(g,h,i)perylene	NM	--	--	--
	Benzo(k)fluoroanthene	NM	--	--	--
	Biphenyl	NM	--	--	--
	Chysene	NM	--	--	--
	Dibenz(a,h)anthracene	NM	--	--	--
	Fluoranthene	NM	--	--	--
	Fluorene	NM	--	--	--
	Indeno(1,2,3-c,d)pyrene	NM	--	--	--
	2-Methylnaphthalene	NM	--	--	--
	Naphthalene	NM	--	--	--
	Perylene	NM	--	--	--
	Phenanthrene	NM	--	--	--
	Phenol	NM	--	--	--
	Pyrene	NM	--	--	--

ND=Non-detect

NM=Not Measured

* All Semi-Volatile Organics are Designated HAPs

Appendix E

Individual Engine Report Tables

Campaign 1 Tables

Table 2-2

GRI Campaign 1 CEM Results
Engine 1
I-R KVG-103

Test Period	**11**
Load Condition	**Intermediate**
Sampling Location	**Exhaust**
Date	**11/04/93**
Test Time	**0746-1334**
Engine Operating Conditions	
Engine Speed (rpm)	327
NG HHV (Btu/scf)	1031
NG LHV (Btu/scf)	930
Exhaust Gas Conditions	
Stack Gas Temperature (°F)	NM
Moisture (%V)	12.0
O2 (%V dry)	6.2
CO2 (%V dry)	6.9
NOx (ppmvd)	800
NOx (ppmvd @ 15% O2)	321
CO (ppmvd)	9691
CO (ppmvd @ 15% O2)	3892
THC (ppmvw)	303
THC (ppmvd @ 15% O2)	138

NM = Not measured.

Table 2-3

GRI Campaign 1 CEM Results
Engine 2
I-R KVG-103

Test Period Load Condition Sampling Location Date Test Time	1 Intermediate Exhaust 10/29/93 1000-1330	2 Intermediate Exhaust 10/29/93 1607-1910	3 Intermediate Exhaust 10/30/93 0935-1150	4 Low Exhaust 10/30/93 1410-1733
Engine Operating Conditions				
Engine Speed (rpm)	327	327	328	291
NG HHV (Btu/scf)	1031	1031	1031	1031
NG LHV (Btu/scf)	930	930	930	930
Exhaust Gas Conditions				
Stack Gas Temperature (°F)	945	945	940	798
Moisture (%V)	16.8	16.8	16.4	15.0
O2 (%V dry)	6.0	5.7	6.3	4.4
CO2 (%V dry)	8.4	8.6	8.3	9.3
NOx (ppmvd)	1384	1351	1536	1719
NOx (ppmvd @ 15% O2)	548	524	621	615
CO (ppmvd)	5281	6042	4008	4074
CO (ppmvd @ 15% O2)	2091	2345	1620	1457
THC (ppmvw)	220	226	191	311
THC (ppmvd @ 15% O2)	104	105	92	131

Table 2-4

GRI Campaign 1 CEM Results
Engine 3
I-R KVG-103

Test Period	**5**	**6**
Load Condition	**Full**	**Intermediate**
Sampling Location	**Exhaust**	**Exhaust**
Date	**10/31/93**	**10/31/93**
Test Time	**1008-1326**	**1520-1756**
Engine Operating Conditions		
Engine Speed (rpm)	328	328
NG HHV (Btu/scf)	1031	1031
NG LHV (Btu/scf)	930	930
Exhaust Gas Conditions		
Stack Gas Temperature (°F)	842	775
Moisture (%V)	13.3	12.0
O2 (%V dry)	9.1	10.6
CO2 (%V dry)	6.7	5.8
NOx (ppmvd)	2077	1687
NOx (ppmvd @ 15% O2)	1038	966
CO (ppmvd)	78.9	86.9
CO (ppmvd @ 15% O2)	39.4	49.8
THC (ppmvw)	235	542
THC (ppmvd @ 15% O2)	135	353

Table 2-5

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 1 I-R KVG-103	Test 11 Intermediate Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	7.24	2.91
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	ND	—
		Ethylene	7.64	3.07
		Formaldehyde (HAP)	4.20	1.69
		Methane	240	96.3
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—

Table 2-6

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 2 I-R KVG-103	Test 1 Intermediate Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	7.27	2.88
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	ND	—
		Ethylene	5.91	2.34
		Formaldehyde (HAP)	3.38	1.34
		Methane	207	82
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—
Engine 2 I-R KVG-103	Test 2 Intermediate Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	7.49	2.91
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	ND	—
		Ethylene	6.31	2.45
		Formaldehyde (HAP)	3.63	1.41
		Methane	217	84
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—
Engine 2 I-R KVG-103	Test 3 Intermediate Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	6.89	2.78
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	ND	—
		Ethylene	5.49	2.22
		Formaldehyde (HAP)	3.35	1.35
		Methane	189	76
		Methanol (HAP)	1.51	0.61
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—

Table 2-6
(Continued)

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 2 I-R KVG-103	Test 4 Low Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	7.05	2.52
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	ND	—
		Ethylene	6.26	2.24
		Formaldehyde (HAP)	4.40	1.57
		Methane	287	103
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—

Table 2-7

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 3 I-R KVG-103	Test 5 Full Load	1,3-Butadiene (HAP)	ND	---
		Acetaldehyde (HAP)	ND	---
		Acetylene	ND	---
		Acrolein (HAP)	ND	---
		Benzene (HAP)	ND	---
		Cyclohexane	ND	---
		Ethane	ND	---
		Ethylene	3.74	1.87
		Formaldehyde (HAP)	12.0	6.00
		Methane	243	122
		Methanol (HAP)	ND	---
		m-Xylene (HAP)	ND	---
		Propylene	ND	---
		Toluene (HAP)	ND	---
Engine 3 I-R KVG-103	Test 6 Intermediate Load	1,3-Butadiene (HAP)	ND	---
		Acetaldehyde (HAP)	ND	---
		Acetylene	2.27	1.30
		Acrolein (HAP)	ND	---
		Benzene (HAP)	ND	---
		Cyclohexane	ND	---
		Ethane	13.5	7.73
		Ethylene	3.71	2.13
		Formaldehyde (HAP)	13.0	7.45
		Methane	586	335.67
		Methanol (HAP)	ND	---
		m-Xylene (HAP)	ND	---
		Propylene	ND	---
		Toluene (HAP)	ND	---

Table 2-8

VOST Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 2 I-R KVG-103	Test 1 Intermediate Load	Benzene (HAP)	0.2	0.06
		Toluene (HAP)	0.05	0.02
		Ethylbenzene (HAP)	0.003	0.001
		Xylene (m,p,o) (HAP)	0.01	0.003
		Styrene (HAP)	0.01	0.003

Table 2-9

CARB Method 430 Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmv)	Stack Conc. (ppmv @ 15% O2)
Engine 2 I-R KVG-103	Test 2 Intermediate Load	Formaldehyde (HAP)	3.2	1.2
		Acetaldehyde (HAP)	0.21	0.081
		Acrolein (HAP)	0.023	0.009
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----
Engine 2 I-R KVG-103	Test 3 Intermediate Load	Formaldehyde (HAP)	2.4	0.97
		Acetaldehyde (HAP)	0.11	0.043
		Acrolein (HAP)	0.012	0.005
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----
Engine 2 I-R KVG-103	Test 4 Low Load	Formaldehyde (HAP)	2.3	0.83
		Acetaldehyde (HAP)	0.14	0.049
		Acrolein (HAP)	0.026	0.009
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----

Table 2-10

CARB Method 430 Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmv)	Stack Conc. (ppmv @ 15% O2)
Engine 3 I-R KVG-103	Test 5 Full Load	Formaldehyde (HAP)	ND	-----
		Acetaldehyde (HAP)	ND	-----
		Acrolein (HAP)	ND	-----
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----
Engine 3 I-R KVG-103	Test 6 Intermediate Load	Formaldehyde (HAP)	ND	-----
		Acetaldehyde (HAP)	ND	-----
		Acrolein (HAP)	ND	-----
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----

Table 2-11

Canister Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 2 I-R KVG-103	Test 1 Intermediate Load	1,2,3-Trimethylbenzene	0.001	0.0005
		1,2,4-Trimethylbenzene	0.23	0.09
		1,3-Butadiene (HAP)	ND	ND
		1,3,5-Trimethylbenzene	0.001	0.0004
		2,2,4-Trimethylpentane (HAP)	0.006	0.002
		Acetylene	ND	ND
		Benzene (HAP)	0.28	0.11
		n-Butane	0.32	0.13
		Cyclohexane	0.008	0.003
		Cyclopentane	0.02	0.006
		Ethane	32.0	12.8
		Ethyl Benzene (HAP)	0.004	0.002
		Ethylene	ND	ND
		n-Hexane (HAP)	0.02	0.009
		Isobutane	0.11	0.04
		Methylcyclohexane	0.005	0.002
		n-Nonane	0.003	0.0010
		n-Octane	0.004	0.002
		Propylene	ND	ND
		Styrene (HAP)	0.003	0.001
		Toluene (HAP)	0.09	0.04
		Xylene (m,p,o) (HAP)	0.02	0.007
Engine 2 I-R KVG-103	Test 4 Low Load	1,2,3-Trimethylbenzene	ND	ND
		1,2,4-Trimethylbenzene	0.48	0.17
		1,3-Butadiene (HAP)	ND	ND
		1,3,5-Trimethylbenzene	ND	ND
		2,2,4-Trimethylpentane (HAP)	0.006	0.002
		Acetylene	ND	ND
		Benzene (HAP)	0.19	0.07
		n-Butane	0.19	0.07
		Cyclohexane	0.005	0.002
		Cyclopentane	ND	ND
		Ethane	20.7	7.40
		Ethyl Benzene (HAP)	0.007	0.002
		Ethylene	ND	ND
		n-Hexane (HAP)	0.03	0.01
		Isobutane	0.49	0.18
		Methylcyclohexane	0.005	0.002
		n-Nonane	ND	ND
		n-Octane	0.006	0.002
		Propylene	ND	ND
		Styrene (HAP)	0.004	0.001
		Toluene (HAP)	0.05	0.02
		Xylene (m,p,o) (HAP)	0.004	0.001

Table 2-12

Canister Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 3 I-R KVG-103	Test 5 Full Load	1,2,3-Trimethylbenzene	ND	ND
		1,2,4-Trimethylbenzene	0.01	0.005
		1,3-Butadiene (HAP)	ND	ND
		1,3,5-Trimethylbenzene	ND	ND
		2,2,4-Trimethylpentane (HAP)	0.008	0.004
		Acetylene	ND	ND
		Benzene (HAP)	0.07	0.03
		n-Butane	0.15	0.08
		Cyclohexane	0.005	0.002
		Cyclopentane	0.06	0.03
		Ethane	12.1	6.05
		Ethyl Benzene (HAP)	0.005	0.003
		Ethylene	ND	ND
		n-Hexane (HAP)	0.03	0.01
		Isobutane	0.25	0.13
		Methylcyclohexane	0.008	0.004
		n-Nonane	0.004	0.002
		n-Octane	0.007	0.004
		Propylene	ND	ND
		Styrene (HAP)	ND	ND
		Toluene (HAP)	0.03	0.02
		Xylene (m,p,o) (HAP)	0.01	0.006

Table 2-13

Semi-VOST Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (µg/dscf)
Engine 3 I-R KVG-103	Test 5 Full Load	Acenaphthene	0.002
		Acenaphthylene	0.02
		Anthrancene	0.001
		Benzo(a)anthracene	ND
		Benzo(a)pyrene	ND
		Benzo(b)fluoranthene	ND
		Benzo(g,h,i)perylene	ND
		Benzo(k)fluoranthene	ND
		Chrysene	ND
		Dibenz(a,h)anthracene	ND
		Fluoranthene	0.003
		Fluorene	0.004
		Indeno(1,2,3-c,d)pyrene	ND
		2-Methylnaphthalene	0.05
		Naphthalene	0.32
		Phenanthrene	0.01
		Phenol	0.37
		Pyrene	0.002

Table 2-14

Trace Metals Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (µg/dscf)
Engine 2 I-R KVG-103	Test 2 Intermediate Load	Antimony	ND
		Arsenic	0.01
		Beryllium	ND
		Cadmium	0.01
		Chromium	0.06
		Cobalt	0.006
		Lead	0.21
		Manganese	0.02
		Mercury	0.0005
		Nickel	0.03
		Selenium	0.006
Engine 2 I-R KVG-103	Test 3 Intermediate Load	Antimony	ND
		Arsenic	0.02
		Beryllium	ND
		Cadmium	0.02
		Chromium	0.11
		Cobalt	0.01
		Lead	0.18
		Manganese	0.14
		Mercury	0.001
		Nickel	0.15
		Selenium	ND

Table 2-15

GRI Campaign 1 CEM Results
Engine 4
C-B 10V-275

Test Period **Load Condition** **Sampling Location** **Date** **Test Time**	**7** **Intermediate** **Exhaust** **11/01/93** **1500-1715**	**8** **Full** **Exhaust** **11/02/93** **0900-1144**
Engine Operating Conditions		
Engine Speed (rpm)	250	276
NG HHV (Btu/scf)	1031	1031
NG LHV (Btu/scf)	930	930
Exhaust Gas Conditions		
Stack Gas Temperature (°F)	503	543
Moisture (%V)	6.0	6.0
O2 (%V dry)	16.0	15.6
CO2 (%V dry)	2.8	3.0
NOx (ppmvd)	160	157
NOx (ppmvd @ 15% O2)	232	175
CO (ppmvd)	105	111
CO (ppmvd @ 15% O2)	155	123
THC (ppmvw)	538	547
THC (ppmvd @ 15% O2)	843	648

Table 2-16

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 4 C-B 10V-275	Test 7 Intermediate Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	1.98	2.38
		Acetylene	ND	—
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	11.7	14.03
		Ethylene	4.70	5.66
		Formaldehyde (HAP)	13.2	15.83
		Methane	516	621.31
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—
Engine 4 C-B 10V-275	Test 8 Full Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	1.55	1.73
		Acetylene	1.26	1.40
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	11.3	12.58
		Ethylene	4.92	5.48
		Formaldehyde (HAP)	13.2	14.69
		Methane	510	568
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—

Table 2-17

Canister Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 4 C-B 10V-275	Test 8 Full Load	1,2,3-Trimethylbenzene	0.004	0.005
		1,2,4-Trimethylbenzene	0.02	0.02
		1,3-Butadiene (HAP)	ND	ND
		1,3,5-Trimethylbenzene	0.002	0.003
		2,2,4-Trimethylpentane (HAP)	0.08	0.09
		Acetylene	ND	ND
		Benzene (HAP)	0.15	0.16
		Butane	1.75	1.95
		Cyclohexane	0.07	0.08
		Cyclopentane	0.02	0.03
		Ethane	87.7	98
		Ethyl Benzene (HAP)	0.007	0.007
		Ethylene	ND	ND
		n-Hexane (HAP)	0.14	0.15
		Isobutane	1.33	1.48
		Methanol (HAP)	ND	ND
		Methylcyclohexane	0.05	0.06
		n-Nonane	0.001	0.001
		n-Octane	0.004	0.004
		Propylene	ND	ND
		Styrene (HAP)	0.01	0.02
		Toluene (HAP)	0.09	0.10
		Xylene (m,p,o) (HAP)	0.02	0.02

Table 2-18

CARB Method 430 Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmv)	Stack Conc. (ppmv @ 15% O2)
Engine 4 Cooper 10V-275	Test 8 Full Load	Formaldehyde (HAP)	10.4	11.6
		Acetaldehyde (HAP)	0.79	0.88
		Acrolein (HAP)	0.25	0.28
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----

Table 2-19

Trace Metals Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (µg/dscf)
Engine 4 C-B 10V-275	Test 8 Full Load	Antimony	ND
		Arsenic	ND
		Beryllium	ND
		Cadmium	0.003
		Chromium	0.02
		Cobalt	0.001
		Lead	0.02
		Manganese	0.56
		Mercury	0.001
		Nickel	0.03
		Selenium	ND

Table 2-20

GRI Campaign 1 CEM Results
Engine 6
Clark TCV-10

Test Period	**9**	**10**
Load Condition	**Full**	**Full**
Sampling Location	**Exhaust**	**Exhaust**
Date	**11/03/93**	**11/03/93**
Test Time	**1000-1252**	**1330-1608**
Engine Operating Conditions		
Engine Speed (rpm)	331	331
NG HHV (Btu/scf)	1032	1032
NG LHV (Btu/scf)	931	931
Exhaust Gas Conditions		
Stack Gas Temperature (°F)	445	442
Moisture (%V)	5.8	5.8
O2 (%V dry)	16.4	16.5
CO2 (%V dry)	2.6	2.5
NOx (ppmvd)	47.7	44.2
NOx (ppmvd @ 15% O2)	62.6	59.3
CO (ppmvd)	392	403
CO (ppmvd @ 15% O2)	514	540
THC (ppmvw)	1819	1911
THC (ppmvd @ 15% O2)	2533	2721

Table 2-21

FTIR Summary Data
GRI Campaign 1

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)
Engine 6 Clark TCV-10	Test 9 Full Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	3.22	4.22
		Acetylene	ND	—
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	47.0	61.62
		Ethylene	12.7	16.65
		Formaldehyde (HAP)	36.9	48.38
		Methane	1749	2,293
		Methanol (HAP)	ND	—
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—
Engine 6 Clark TCV-10	Test 10 Full Load	1,3-Butadiene (HAP)	ND	—
		Acetaldehyde (HAP)	ND	—
		Acetylene	ND	—
		Acrolein (HAP)	ND	—
		Benzene (HAP)	ND	—
		Cyclohexane	ND	—
		Ethane	51.2	67.2
		Ethylene	14.0	18.3
		Formaldehyde (HAP)	38.8	50.8
		Methane	1933	2535
		Methanol (HAP)	0.94	1.24
		m-Xylene (HAP)	ND	—
		Propylene	ND	—
		Toluene (HAP)	ND	—

Table 2-22

VOST Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 6 Clark TCV-10	Test 10 Full Load	Benzene (HAP)	0.1	0.12
		Toluene (HAP)	0.03	0.04
		Ethylbenzene (HAP)	0.003	0.003
		Xylene (m,p,o) (HAP)	0.01	0.02
		Styrene (HAP)	ND	----

Table 2-23

CARB Method 430 Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmv)	Stack Conc. (ppmv @ 15% O2)
Engine 6 Clark TCV-10	Test 9 Full Load	Formaldehyde (HAP)	17.2	22.6
		Acetaldehyde (HAP)	1.10	1.44
		Acrolein (HAP)	0.54	0.71
		Butyraldehyde	ND	-----
		Isobutyraldehyde	ND	-----

Table 2-24

Canister Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)
Engine 6 Clark TCV-10	Test 9 Full Load	1,2,3-Trimethylbenzene	ND	ND
		1,2,4-Trimethylbenzene	0.004	0.005
		1,3-Butadiene (HAP)	0.04	0.06
		1,3,5-Trimethylbenzene	0.002	0.002
		2,2,4-Trimethylpentane (HAP)	0.05	0.06
		Acetylene	ND	ND
		Benzene (HAP)	0.13	0.17
		Butane	1.23	1.61
		Cyclohexane	0.06	0.08
		Cyclopentane	0.004	0.006
		Ethane	337	442
		Ethyl Benzene (HAP)	0.006	0.01
		Ethylene	ND	ND
		n-Hexane (HAP)	0.15	0.20
		Isobutane	1.07	1.40
		Methylcyclohexane	0.06	0.08
		n-Nonane	0.008	0.01
		n-Octane	0.03	0.04
		Propylene	ND	ND
		Styrene (HAP)	0.007	0.01
		Toluene (HAP)	0.07	0.09
		Xylene (m,p,o) (HAP)	0.03	0.04

Table 2-25

Semi-VOST Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (µg/dscf)
Engine 6 Clark TCV-10	Test 10 Full Load	Acenaphthene	ND
		Acenaphthylene	ND
		Anthrancene	ND
		Benzo(a)anthracene	ND
		Benzo(a)pyrene	ND
		Benzo(b)fluoranthene	ND
		Benzo(g,h,i)perylene	ND
		Benzo(k)fluoranthene	ND
		Chrysene	ND
		Dibenz(a,h)anthracene	ND
		Fluoranthene	ND
		Fluorene	ND
		Indeno(1,2,3-c,d)pyrene	ND
		2-Methylnaphthalene	0.05
		Naphthalene	0.08
		Phenanthrene	0.007
		Phenol	0.32
		Pyrene	ND

Table 2-26

Trace Metals Results
GRI Campaign 1

Engine	Condition	Pollutant	Stack Conc. (µg/dscf)
Engine 6 Clark TCV-10	Test 9 Full Load	Antimony	ND
		Arsenic	0.006
		Beryllium	ND
		Cadmium	0.001
		Chromium	0.06
		Cobalt	0.007
		Lead	0.20
		Manganese	0.10
		Mercury	0.002
		Nickel	0.05
		Selenium	0.009

Table 2-27

Engine Fuel Analysis
GRI Campaign 1

VOC Compounds	Engine #2 (ppmv)	Engine #3 (ppmv)	Engine #4 (ppmv)	Engine #6 (ppmv)
1,3-Butadiene	ND	ND	ND	ND
2,2,4-Trimethylpentane	3.8	3.0	3.0	8.2
Benzene	1.5	1.8	1.8	35.3
Cyclohexane	13.6	14.0	13.9	33.8
Cyclopentane	2.6	2.6	2.7	9.7
Ethyl Benzene	0.13	ND	0.26	1.2
Methycyclopentane	12.5	13.1	13.3	32.8
Toluene	1.7	1.8	1.8	12.8
Xylene (m,p,o)	1.1	0.94	0.34	6.4
n-Butane	633	628	637	743
n-Hexane	89.3	88.1	89.5	78.3
n-Heptane	41.5	43.4	41.4	33.3
Methane (%)	94.3	94.0	95.0	87.7
Ethane (%)	2.6	2.6	2.7	2.4
Propane (%)	0.30	0.30	0.30	0.38

Campaign 3 Tables

Table 4-2

Station 3A CEM Results
Engine 102
C-B LSV-16

Test Period	1	2	3
Load Condition	Full	Full	Low
Date	6/14/94	6/15/94	6/15/94
Test Time	1600-2100	0832-1314	1437-1637
Ambient Conditions			
Barometric Press (" Hg)	29.22	29.22	29.20
Ambient Temperature (F)	87	83	80
Relative Humidity (%)	62.0	73.0	87.0
Absolute Humidity (lb H2O/1000 lb dry air)	17.87	18.35	19.74
Engine Operating Conditions			
Brake horsepower (BHP)	4055	4202	3364
Load (%)	98.0	101	87.0
Engine Speed (rpm)	321	325	302
Fuel Flow (scf/min)	487	497	412
Heat Input (MMBtu/hr) (a)	33.3	33.7	28.0
Heat Rate(Btu/BHP-hr, HHV)	8348	8145	8440
Heat Rate(Btu/BHP-hr, LHV)	7556	7372	7639
NG HHV (Btu/scf)	1159	1148	1148
NG LHV (Btu/scf)	1049	1039	1039
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	7381	6947	6381
Vol. Flow (dscfm) - M 19, Fd (b)	8735	8678	7526
Stack gas temp (F)	976	976	968
Moisture (%V)	13.0	14.1	11.9
O2 (%V)	9.6	9.4	9.9
CO2 (%V) (c)	6.33	6.33	6.0
NOx (ppmvd)	1749	1657	825
CO (ppmvd)	203	217	247
THC (ppmvw)	1666	1677	1803
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	913	850	442
NOx (lb/hr)	109	102.9	44.4
NOx (g/BHP-hr)	12.2	11.1	6.0
NOx (lb/MMBtu)	3.3	3.1	1.6
NOx (tons/yr)	479	451	195
CO (ppmvd @ 15% O2)	106	111	132
CO (lb/hr)	7.7	8.2	8.1
CO (g/BHP-hr)	0.9	0.9	1.1
CO (lb/MMBtu)	0.2	0.2	0.3
CO (tons/yr)	33.8	35.9	35.4
THC (ppmvd @ 15% O2)	1000	1002	1097
THC (lb/hr)	41.7	42.2	38.3
THC (g/BHP-hr)	4.7	4.6	5.2
THC (lb/MMBtu)	1.2	1.3	1.4
THC (tons/yr)	182	185	168

a Based on HHV

b Used in emission rate calculations

c CEM analyzer not operating, FTIR CO2 values shown

Note: Heating values based on 60°F reference.

M19 flow rates based on 68°F reference.

ENG102-A.WK4

11/02/95

Table 4-3

Station 3A CEM Results
Engine 101
C-B LSV-16

Test Period	1	2	3
Load Condition	Low	Full	Full
Date	6/15/94	6/16/94	6/16/94
Test Time	1831-1935	0915-1405	1415-1806
Ambient Conditions			
Barometric Press (" Hg)	29.60	29.40	29.20
Ambient Temperature (F)	84	80	89
Relative Humidity (%)	72.0	78.0	58.0
Absolute Humidity (lb H2O/1000lb dry air)	18.48	17.58	17.90
Engine Operating Conditions			
Brake horsepower (BHP)	3311	4056	4117
Load (%)	85.0	98.0	99.0
Engine Speed (rpm)	303	321	325
Fuel Flow (scf/min)	423	478	486
Heat Input (MMBtu/hr) (a)	28.7	32.4	33.0
Heat Rate(Btu/BHP-hr, HHV)	8800	8118	8126
Heat Rate(Btu/BHP-hr, LHV)	7964	7347	7355
NG HHV (Btu/scf)	1148	1148	1148
NG LHV (Btu/scf)	1039	1039	1039
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	7125	7195	7319
Vol. Flow (dscfm) - M 19, Fd (b)	8581	8421	8409
Stack gas temp (F)	922	962	970
Moisture (%V)	12.2	13.5	13.5
O2 (%V)	11.0	9.5	9.3
CO2 (%V) (c)	5.51	6.15	6.11
NOx (ppmvd)	259	1297	1544
CO (ppmvd)	209	258	258
THC (ppmvw)	2269	1950	1879
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	154	671	785
NOx (lb/hr)	15.9	78.2	93.0
NOx (g/BHP-hr)	2.2	8.7	10.2
NOx (lb/MMBtu)	0.6	2.4	2.8
NOx (tons/yr)	69.7	342.5	407.2
CO (ppmvd @ 15% O2)	124	134	131
CO (lb/hr)	7.8	9.5	9.4
CO (g/BHP-hr)	1.1	1.1	1.0
CO (lb/MMBtu)	0.3	0.3	0.3
CO (tons/yr)	34.2	41.5	41.3
THC (ppmvd @ 15% O2)	1540	1167	1105
THC (lb/hr)	55.2	47.3	45.5
THC (g/BHP-hr)	7.6	5.3	5.0
THC (lb/MMBtu)	1.9	1.5	1.4
THC (tons/yr)	242	207	199

a Based on HHV

b Used in emission rate calculations

c CEM analyzer not operating, FTIR CO2 values shown

Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

11/10/95

ENG101-A.WK4

Table 4-6

Station 3A FTIR Results

Engine	Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(lb/MMBtu)	(tons/yr)
102 LSV-16	Test 2 101% Load	Acetaldehyde (HAP)	ND	—	—	—	—	—
		Acetylene	3.75	1.92	0.13	0.01	0.004	0.58
		Acrolein (HAP)	ND	—	—	—	—	—
		Ethane	35.2	18.1	1.43	0.15	0.04	6.25
		Ethylene	6.95	3.57	0.26	0.03	0.01	1.15
		Formaldehyde (HAP)	31.1	16.0	1.26	0.14	0.04	5.53
		Methane	1940	995	41.9	4.53	1.24	184
		Methanol (HAP)	0.77	0.40	0.03	0.004	0.001	0.15
		Propylene	ND	—	—	—	—	—
102 LSV-16	Test 3 87% Load	Acetaldehyde (HAP)	ND	—	—	—	—	—
		Acetylene	10.4	5.58	0.32	0.04	0.01	1.39
		Acrolein (HAP)	ND	—	—	—	—	—
		Ethane	33.7	18.08	1.18	0.16	0.04	5.19
		Ethylene	ND	—	—	—	—	—
		Formaldehyde (HAP)	35.3	19.0	1.24	0.17	0.04	5.44
		Methane	1912	1026	35.8	4.83	1.28	157
		Methanol (HAP)	0.97	0.52	0.04	0.005	0.001	0.16
		Propylene	1.78	0.95	0.09	0.01	0.003	0.38
101 LSV-16	Test 1 85% Load	Acetaldehyde (HAP)	ND	—	—	—	—	—
		Acetylene	3.14	1.87	0.11	0.01	0.004	0.48
		Acrolein (HAP)	ND	—	—	—	—	—
		Ethane	43.3	25.8	1.73	0.24	0.06	7.60
		Ethylene	12.2	7.25	0.46	0.06	0.02	1.99
		Formaldehyde (HAP)	33.0	19.7	1.32	0.18	0.05	5.79
		Methane	2611	1556	55.8	7.64	1.94	244
		Methanol (HAP)	0.84	0.50	0.04	0.005	0.001	0.16
		Propylene	ND	—	—	—	—	—
101 LSV-16	Test 2 98% Load	Acetaldehyde (HAP)	ND	—	—	—	—	—
		Acetylene	3.66	1.89	0.12	0.01	0.004	0.55
		Acrolein (HAP)	ND	—	—	—	—	—
		Ethane	37.1	19.2	1.46	0.16	0.04	6.38
		Ethylene	8.3	4.30	0.30	0.03	0.01	1.33
		Formaldehyde (HAP)	33.1	17.1	1.30	0.15	0.04	5.70
		Methane	2178	1127	45.7	5.11	1.41	200
		Methanol (HAP)	0.91	0.47	0.04	0.004	0.001	0.17
		Propylene	ND	—	—	—	—	—
101 LSV-16	Test 3 99% Load	Acetaldehyde (HAP)	ND	—	—	—	—	—
		Acetylene	4.19	2.13	0.14	0.02	0.004	0.62
		Acrolein (HAP)	ND	—	—	—	—	—
		Ethane	35.7	18.2	1.40	0.15	0.04	6.15
		Ethylene	7.86	4.00	0.29	0.03	0.01	1.26
		Formaldehyde (HAP)	31.2	15.8	1.22	0.13	0.04	5.36
		Methane	1963	998	41.1	4.53	1.25	180
		Methanol (HAP)	0.81	0.41	0.03	0.004	0.001	0.15
		Propylene	ND	—	—	—	—	—

Table 4-8

Canister Results

Engine	Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(lb/MMBtu)	(tons/yr)
102 LSV-16 Station 3A	Test 1 98% Load	1,2,4-Trimethylbenzene	ND	ND	—	—	—	—
		1,3-Butadiene (HAP)	ND	ND	—	—	—	—
		1,3,5-Trimethylbenzene	ND	ND	—	—	—	—
		2,2,4-Trimethylpentane (HAP)	ND	ND	—	—	—	—
		Benzene (HAP)	0.009	0.005	9.2E-04	1.0E-04	2.8E-05	4.0E-03
		Butane	0.20	0.11	1.6E-02	1.8E-03	4.8E-04	7.0E-02
		Cyclohexane	ND	ND	—	—	—	—
		Cyclopentane	ND	ND	—	—	—	—
		Ethane	20.6	10.8	8.4E-01	9.4E-02	2.5E-02	3.7E+00
		Ethyl Benzene (HAP)	ND	ND	—	—	—	—
		n-Hexane (HAP)	0.006	0.003	6.4E-04	7.2E-05	1.9E-05	2.8E-03
		Methylcyclohexane	ND	ND	—	—	—	—
		n-Octane	ND	ND	—	—	—	—
		n-Pentane	0.02	0.01	2.3E-03	2.6E-04	7.0E-05	1.0E-02
		Propane	1.85	0.97	1.1E-01	1.2E-02	3.3E-03	4.9E-01
		Styrene (HAP)	0.003	0.002	4.4E-04	4.9E-05	1.3E-05	1.9E-03
		Toluene (HAP)	ND	ND	—	—	—	—
		(m,p,o)-Xylene (HAP)	ND	ND	—	—	—	—
101 LSV-16 Station 3A	Test 2 98% Load	1,2,4-Trimethylbenzene	ND	ND	—	—	—	—
		1,3-Butadiene (HAP)	ND	ND	—	—	—	—
		1,3,5-Trimethylbenzene	ND	ND	—	—	—	—
		2,2,4-Trimethylpentane (HAP)	ND	ND	—	—	—	—
		Benzene (HAP)	0.03	0.01	2.7E-03	3.1E-04	8.5E-05	1.2E-02
		Butane	0.26	0.14	2.0E-02	2.2E-03	6.2E-04	8.7E-02
		Cyclohexane	ND	ND	—	—	—	—
		Cyclopentane	ND	ND	—	—	—	—
		Ethane	32.9	17.0	1.3E+00	1.5E-01	4.0E-02	5.7E+00
		Ethyl Benzene (HAP)	ND	ND	—	—	—	—
		n-Hexane (HAP)	0.002	0.001	2.6E-04	2.9E-05	8.0E-06	1.1E-03
		Methylcyclohexane	ND	ND	—	—	—	—
		n-Octane	ND	ND	—	—	—	—
		n-Pentane	0.02	0.01	1.9E-03	2.1E-04	5.8E-05	8.3E-03
		Propane	2.81	1.45	1.6E-01	1.8E-02	5.0E-03	7.1E-01
		Styrene (HAP)	ND	ND	—	—	—	—
		Toluene (HAP)	ND	ND	—	—	—	—
		(m,p,o)-Xylene (HAP)	ND	ND	—	—	—	—

Table 4-9

Station 3A GC Results

Engine	Condition	Pollutant	Conc. (ppmvw)	Stack Conc. (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (lb/MMBtu)	Emission Rate (tons/yr)
102 LSV-16	Test 1 98% Load	Methane	1674	1924	1005	41.9	4.69	1.26	183
		Ethane	24.2	27.8	14.5	1.14	0.13	0.034	4.98
		C1 (as methane)	1680	1931	1008	42.1	4.71	1.26	184
		C2 (as ethane)	24.6	28.3	14.8	1.16	0.13	0.035	5.06
		C3 (as propane)	12.7	14.6	7.62	0.88	0.10	0.026	3.83
		C4 (as butane)	2.03	2.33	1.22	0.18	0.02	0.006	0.81
		C5 (as pentane)	1.52	1.75	0.91	0.17	0.02	0.005	0.75
		C6 (as hexane)	1.14	1.31	0.68	0.15	0.02	0.005	0.67
		C7 (as heptane)	1.54	1.77	0.92	0.24	0.03	0.007	1.06
		Total C1-C7 (as methane)	1789	2056	1074	44.8	5.02	1.35	196
102 LSV-16	Test 2 101% Load	Methane	2204	2566	1316	55.4	5.99	1.65	243
		Ethane	33.6	39.1	20.1	1.59	0.17	0.047	6.96
		C1 (as methane)	2215	2579	1323	55.9	6.04	1.66	245
		C2 (as ethane)	33.7	39.2	20.1	1.59	0.17	0.047	6.98
		C3 (as propane)	11.9	13.9	7.11	0.82	0.09	0.024	3.61
		C4 (as butane)	2.53	2.95	1.51	0.23	0.02	0.007	1.01
		C5 (as pentane)	1.35	1.57	0.81	0.15	0.02	0.005	0.67
		C6 (as hexane)	0.72	0.84	0.43	0.10	0.01	0.003	0.43
		C7 (as heptane)	2.55	2.97	1.52	0.40	0.04	0.012	1.76
		Total C1-C7 (as methane)	2341	2725	1398	59.0	6.38	1.75	259
101 LSV-16	Test 2 98% Load	Methane	2023	2339	1210	49.0	5.49	1.51	215
		Ethane	31.9	36.9	19.1	1.45	0.16	0.045	6.4
		C1 (as methane)	2034	2351	1217	49.4	5.53	1.53	217
		C2 (as ethane)	32.0	37.0	19.1	1.46	0.16	0.045	6.39
		C3 (as propane)	13.3	15.4	7.96	0.89	0.10	0.027	3.89
		C4 (as butane)	3.24	3.75	1.94	0.29	0.03	0.009	1.25
		C5 (as pentane)	1.49	1.72	0.89	0.16	0.02	0.005	0.71
		C6 (as hexane)	0.65	0.75	0.39	0.08	0.01	0.003	0.37
		C7 (as heptane)	2.95	3.41	1.77	0.45	0.05	0.014	1.96
		Total C1-C7 (as methane)	2227	2575	1332	54.1	6.06	1.67	237
101 LSV-16	Test 3 99% Load	Methane	2114	2444	1243	51.2	5.64	1.55	224
		Ethane	33.0	38.2	19.4	1.50	0.17	0.05	6.58
		C1 (as methane)	2124	2455	1249	51.5	5.68	1.56	226
		C2 (as ethane)	33.1	38.3	19.5	1.51	0.17	0.05	6.60
		C3 (as propane)	13.4	15.5	7.88	0.89	0.10	0.027	3.92
		C4 (as butane)	3.77	4.36	2.22	0.33	0.04	0.010	1.45
		C5 (as pentane)	1.81	2.09	1.06	0.20	0.02	0.006	0.87
		C6 (as hexane)	0.73	0.84	0.43	0.10	0.01	0.0029	0.42
		C7 (as heptane)	2.97	3.43	1.75	0.45	0.05	0.014	1.97
		Total C1-C7 (as methane)	2262	2615	1330	54.9	6.05	1.66	240

Table 4-11

CARB Method 430 Results

Station	Engine	Test Period	Load Condition	Pollutant	Stack Conc. (ppmv)
3A	102 LSV-16	1	Full	Formaldehyde (HAP)	0.05
				Acetaldehyde (HAP)	0.09
				Acrolein (HAP)	0.02
				Butyrald/Isobutyraldehyde	0.07
				Propionaldehyde	0.01
	102 LSV-16	2	Full	Formaldehyde (HAP)	0.11
				Acetaldehyde (HAP)	ND
				Acrolein (HAP)	ND
				Butyrald/Isobutyraldehyde	0.17
				Propionaldehyde	ND
	101 LSV-16	2	Full	Formaldehyde (HAP)	ND
				Acetaldehyde (HAP)	ND
				Acrolein (HAP)	ND
				Butyrald/Isobutyraldehyde	0.03
				Propionaldehyde	ND
	101 LSV-16	3	Full	Formaldehyde (HAP)	0.05
				Acetaldehyde (HAP)	ND
				Acrolein (HAP)	ND
				Butyrald/Isobutyraldehyde	0.05
				Propionaldehyde	ND
3B	2 GMV-10TF	4	Full	Formaldehyde (HAP)	0.15
				Acetaldehyde (HAP)	0.34
				Acrolein (HAP)	0.22
				Butyrald/Isobutyraldehyde	0.07
				Propionaldehyde	0.05
	2 GMV-10TF	4	Full	Formaldehyde (HAP)	1.57
				Acetaldehyde (HAP)	0.53
				Acrolein (HAP)	0.58
				Butyrald/Isobutyraldehyde	0.08
				Propionaldehyde	0.08

Note: Sample spike results suggest interference from unknown flue gas constituents which consumed the DNPH solution (See Section 5.3.1).

Table 4-12

Semi-VOST Results

Engine	Condition	Pollutant	Conc. (µg/dscf)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
102 LSV-16 Station 3A	Test 1 98% Load	Acenaphthene	ND	—	—	—
		Acenaphthylene	ND	—	—	—
		Anthrancene	ND	—	—	—
		Benzo(a)anthracene	ND	—	—	—
		Benzo(a)pyrene	ND	—	—	—
		Benzo(e)pyrene	ND	—	—	—
		Benzo(b)fluoranthene	ND	—	—	—
		Benzo(g,h,i)perylene	ND	—	—	—
		Benzo(k)fluoranthene	ND	—	—	—
		Biphenyl	7.10	8.2E-03	9.2E-04	3.6E-02
		Chrysene	ND	—	—	—
		Dibenz(a,h)anthracene	ND	—	—	—
		Dibenzofuran	1.23	1.4E-03	1.6E-04	6.2E-03
		Fluoranthene	ND	—	—	—
		Fluorene	0.18	2.1E-04	2.3E-05	9.1E-04
		Indeno(1,2,3-c,d)pyrene	ND	—	—	—
		2-Methylnaphthalene	ND	—	—	—
		Naphthalene	0.35	4.0E-04	4.5E-05	1.8E-03
		Perylene	ND	—	—	—
		Phenanthrene	ND	—	—	—
		Phenol	1.09	1.3E-03	1.4E-04	5.5E-03
		Pyrene	ND	—	—	—
101 LSV-16 Station 3A	Test 2 98% Load	Acenaphthene	ND	—	—	—
		Acenaphthylene	ND	—	—	—
		Anthrancene	ND	—	—	—
		Benzo(a)anthracene	ND	—	—	—
		Benzo(a)pyrene	ND	—	—	—
		Benzo(e)pyrene	ND	—	—	—
		Benzo(b)fluoranthene	ND	—	—	—
		Benzo(g,h,i)perylene	ND	—	—	—
		Benzo(k)fluoranthene	ND	—	—	—
		Biphenyl	5.18	5.8E-03	6.5E-04	2.5E-02
		Chrysene	ND	—	—	—
		Dibenz(a,h)anthracene	ND	—	—	—
		Dibenzofuran	ND	—	—	—
		Fluoranthene	ND	—	—	—
		Fluorene	0.40	4.5E-04	5.0E-05	1.9E-03
		Indeno(1,2,3-c,d)pyrene	ND	—	—	—
		2-Methylnaphthalene	ND	—	—	—
		Naphthalene	0.25	2.8E-04	3.1E-05	1.2E-03
		Perylene	ND	—	—	—
		Phenanthrene	ND	—	—	—
		Phenol	0.30	3.3E-04	3.7E-05	1.5E-03
		Pyrene	ND	—	—	—

Table 4-13

PM_{10} Results

Engine	Condition	Pollutant	Conc. (gr/dscf)	Emission Rate (lb/hr)	(g/BHP-hr)	(lb/MMBtu)	(tons/yr)
102		PM-10	0.00002	1.5E-03	1.6E-04	4.3E-05	6.5E-03
LSV-16	Test 2	Organic Condensible PM	0.003	2.4E-01	2.6E-02	7.1E-03	1.1E+00
Station 3A	101% Load	Inorganic Condensible PM	0.003	2.5E-01	2.6E-02	7.2E-03	1.1E+00
101		PM-10	0.00005	3.6E-03	4.0E-04	1.1E-04	1.6E-02
LSV-16	Test 3	Organic Condensible PM	0.001	1.0E-01	1.1E-02	3.0E-03	4.5E-01
Station 3A	99% Load	Inorganic Condensible PM	0.002	1.1E-01	1.2E-02	3.4E-03	4.9E-01
2		PM-10 *	--	--	--	--	--
GMV-10TF	Test 2	Organic Condensible PM	0.02	8.1E-01	3.2E-01	7.7E-02	3.5E+00
Station 3B	104% Load	Inorganic Condensible PM	0.003	1.1E-01	4.2E-02	1.0E-02	4.6E-01
2		PM-10	0.0004	1.2E-02	4.6E-03	1.1E-03	5.1E-02
GMV-10TF	Test 3	Organic Condensible PM	0.0004	1.2E-02	4.9E-03	1.2E-03	5.4E-02
Station 3B	104% Load	Inorganic Condensible PM	0.002	8.0E-02	3.2E-02	7.6E-03	3.5E-01

* Filter was torn during sampling

Table 4-14

Fuel Gas Canister Results (ppmvd)

Pollutant	Station 3A 06/14/94	Station 3A 06/16/94	Station 3B 06/18/94	Station 3B 06/19/94
1,2,4-Trimethylbenzene	2.07	0.88	0.17	0.16
1,3-Butadiene (HAP)	ND	ND	ND	ND
1,3,5-Trimethylbenzene	2.98	1.39	0.16	0.16
2,2,4-Trimethylpentane (HAP)	10.9	5.88	1.11	2.22
Benzene (HAP)	98.0	42.4	0.75	1.41
Butane	818	395	852	915
Cyclohexane	57.1	29.0	3.98	7.06
Cyclopentane	16.1	8.45	3.44	4.70
Ethane	19600	8600	194000	189000
Ethyl Benzene (HAP)	4.03	1.87	ND	ND
n-Hexane (HAP)	95.4	54.1	16.3	26.2
Isobutane	758	420	297	322
Methylcyclohexane	61.3	32.8	3.16	6.11
n-Nonane	9.22	4.86	0.43	0.39
n-Octane	24.9	13.7	1.12	1.44
Styrene (HAP)	0.89	0.43	ND	ND
Toluene (HAP)	69.2	30.1	0.48	0.66
(m,p,o)-Xylene (HAP)	25.4	10.7	0.24	0.28

Campaign 4 Tables

Table 4-2

Station CEM Results
Waukesha L7042GU

Test Period	3	4
Load Condition	Intermediate	Low
Sampling Location	Before NSCR	Before NSCR
Date	8/23/94	8/24/94
Test Time	1805-2028	1020-1201
Ambient Conditions		
Barometric Pressure (in. Hg)	29.47	29.55
Ambient Temperature (°F)	74	87
Relative Humidity (%)	65.4	36.7
Abs. Humidity (lb H2O/lb dry air)	12.0	10.4
Engine Operating Conditions		
Brake horsepower (BHP)	644	362
Load (%)	88	52
Engine Speed (rpm)	813	779
Fuel Flow (scf/min) (a)	82.8	54.7
Heat Input (MMBtu/hr) (b)	4.95	3.28
Heat Rate (Btu/BHP-hr, HHV)	7809	9185
Heat Rate (Btu/BHP-hr, LHV)	7035	8279
NG HHV (Btu/scf)	1011	1013
NG LHV (Btu/scf)	911	913
Exhaust Gas Conditions		
Vol. Flow (dscfm) - M 2 (c)	1274	474
Vol. Flow (dscfm) - M19, Fd	716	472
Stack Gas Temperature (°F)	796	641
Moisture (%V)	20.7	20.5
O2 (%V)	0.42	0.35
CO2 (%V)	11.2	11.5
NOx (ppmvd)	2843	2542
CO (ppmvd)	3714	2690
THC (ppmvw)	1048	1394
Exhaust Emissions		
NOx (ppmvd @ 15% O2)	819	730
NOx (lb/hr)	25.9	8.6
NOx (g/BHP-hr)	18.3	10.8
NOx (lb/MMBtu)	5.24	2.63
NOx (tons/yr)	114	37.8
CO (ppmvd @ 15% O2)	1070	772
CO (lb/hr)	20.6	5.56
CO (g/BHP-hr)	14.5	6.96
CO (lb/MMBtu)	4.16	1.70
CO (tons/yr)	90.3	24.3
THC (ppmvd @ 15% O2)	381	504
THC (lb/hr)	4.19	2.07
THC (g/BHP-hr)	2.96	2.59
THC (lb/MMBtu)	0.85	0.63
THC (tons/yr)	18.4	9.1

a Fuel flow rate is suspect due to data collection difficulties.
b Based on HHV
c Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-3

Station CEM Results
Waukesha L7042GU
After NSCR

Test Period	1	2	5
Load Condition	Full	Full	Low
Sampling Location	After NSCR	After NSCR	After NSCR
Date	8/23/94	8/23/94	8/24/94
Test Time	1146-1345	1424-1722	1210-1306
Ambient Conditions			
Barometric Pressure (in. Hg)	29.54	29.49	29.54
Ambient Temperature (°F)	87	87	92
Relative Humidity (%)	35.2	40.1	27.2
Abs. Humidity (lb H2O/lb dry air)	10.1	11.3	9.3
Engine Operating Conditions			
Brake horsepower (BHP)	692	671	359
Load (%)	95	92	51
Engine Speed (rpm)	809	811	779
Fuel Flow (scf/min) (a)	88.0	84.6	54.7
Heat Input (MMBtu/hr) (b)	5.26	5.05	3.28
Heat Rate (Btu/BHP-hr, HHV)	7717	7646	9275
Heat Rate (Btu/BHP-hr, LHV)	6952	6888	8360
NG HHV (Btu/scf)	1011	1011	1013
NG LHV (Btu/scf)	911	911	913
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2 (c)	1274	1274	474
Vol. Flow (dscfm) - M19, Fd	746	718	464
Stack Gas Temperature (°F)	796	796	641
Moisture (%V)	20.7	20.7	20.5
O2 (%V)	0.04	0.06	0.00
CO2 (%V)	11.7	11.7	12.0
NOx (ppmvd)	8.03	8.38	35.3
CO (ppmvd)	68.5	69.5	35.8
THC (ppmvw)	607	640	846
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	2.27	2.37	10.0
NOx (lb/hr)	0.07	0.08	0.12
NOx (g/BHP-hr)	0.05	0.05	0.15
NOx (lb/MMBtu)	0.01	0.02	0.04
NOx (tons/yr)	0.32	0.33	0.53
CO (ppmvd @ 15% O2)	19.4	19.7	10.1
CO (lb/hr)	0.38	0.39	0.07
CO (g/BHP-hr)	0.25	0.26	0.09
CO (lb/MMBtu)	0.07	0.08	0.02
CO (tons/yr)	1.67	1.69	0.32
THC (ppmvd @ 15% O2)	217	228	301
THC (lb/hr)	2.43	2.56	1.26
THC (g/BHP-hr)	1.59	1.73	1.59
THC (lb/MMBtu)	0.46	0.51	0.38
THC (tons/yr)	10.6	11.2	5.5

a Fuel flow rate is suspect due to data collection difficulties.
b Based on HHV
c Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-4

Station CEM Results
Engine 1
C-B GMVA-10

Test Period	6
Load Condition	Intermediate
Sampling Location	Exhaust
Date	8/25/94
Test Time	0952-1020
Ambient Conditions	
Barometric Pressure (in. Hg)	29.52
Ambient Temperature (°F)	84
Relative Humidity (%)	34.7
Abs. Humidity (lb H2O/lb dry air)	8.9
Engine Operating Conditions	
Brake horsepower (BHP)	1159
Load (%)	87
Engine Speed (rpm)	296
Fuel Flow (scf/min) (a)	--
Heat Input (MMBtu/hr)	--
Heat Rate (Btu/BHP-hr, HHV)	--
Heat Rate (Btu/BHP-hr, LHV)	--
NG HHV (Btu/scf)	1009
NG LHV (Btu/scf)	910
Exhaust Gas Conditions	
Vol. Flow (dscfm) - M 2	NA
Vol. Flow (dscfm) - M19, Fd	--
Stack Gas Temperature (°F)	517
Moisture (%V)	7.30
O2 (%V)	14.6
CO2 (%V)	3.43
NOx (ppmvd)	141
CO (ppmvd)	79.0
THC (ppmvw)	1353
Exhaust Emissions	
NOx (ppmvd @ 15% O2)	132
NOx (lb/hr)	--
NOx (g/BHP-hr)	--
NOx (lb/MMBtu)	--
NOx (tons/yr)	--
CO (ppmvd @ 15% O2)	73.9
CO (lb/hr)	--
CO (g/BHP-hr)	--
CO (lb/MMBtu)	--
CO (tons/yr)	--
THC (ppmvd @ 15% O2)	1364
THC (lb/hr)	--
THC (g/BHP-hr)	--
THC (lb/MMBtu)	--
THC (tons/yr)	--

a Fuel flow measurements from this engine are considered suspect. Due to the computational procedures employed, these inaccuracies affect heat input, heat rate, exhaust flowrate, emission flowrates, and emission factors; therefore, these parameters are not calculated.

Table 4-5

Station CEM Results
Engine 4
C-B GMVC-10C

Test Period Load Condition Sampling Location Date Test Time	7 Full Before Catalyst 8/25/94 1705-1906	9 Full Before Catalyst 8/26/94 1310-1537	H Full Before Catalyst 8/30/94 1555-1618	I Low Before Catalyst 8/30/94 1656-1735
Ambient Conditions				
Barometric Pressure (in. Hg)	29.44	29.47	29.36	29.35
Ambient Temperature (°F)	85	89	85	84
Relative Humidity (%)	37.8	40.5	29.4	44.8
Abs. Humidity (lb H2O/lb dry air)	10.1	12.4	8.0	11.4
Engine Operating Conditions				
Brake horsepower (BHP)	1732	1674	1705	1422
Load (%)	97	93	95	79
Engine Speed (rpm)	299	300	299	299
Fuel Flow (scf/min)	211	213	212	185
Heat Input (MMBtu/hr) (a)	12.6	12.7	12.7	11.0
Heat Rate (Btu/BHP-hr, HHV)	7368	7706	7550	7880
Heat Rate (Btu/BHP-hr, LHV)	6640	6945	6803	7100
NG HHV (Btu/scf)	1009	1009	1011	1011
NG LHV (Btu/scf)	910	910	911	911
Exhaust Gas Conditions				
Vol. Flow (dscfm) - M 2	8486	NA	8338	8371
Vol. Flow (dscfm) - M19, Fd (b)	6920	6866	6633	6039
Stack Gas Temperature (°F)	574	517	506	507
Moisture (%V)	7.26	7.30	8.20	7.95
O2 (%V)	15.5	15.4	15.3	15.5
CO2 (%V)	2.86	2.96	2.92	2.81
NOx (ppmvd)	39.2	34.1	36.9	20.2
CO (ppmvd)	162	181	178	237
THC (ppmvw)	1218	1559	1426	1948
Exhaust Emissions				
NOx (ppmvd @ 15% O2)	43.1	36.9	38.6	22.1
NOx (lb/hr)	1.94	1.68	1.75	0.87
NOx (g/BHP-hr)	0.51	0.45	0.47	0.28
NOx (lb/MMBtu)	0.15	0.13	0.14	0.08
NOx (tons/yr)	8.50	7.35	7.67	3.83
CO (ppmvd @ 15% O2)	179	195	186	260
CO (lb/hr)	4.89	5.41	5.15	6.25
CO (g/BHP-hr)	1.28	1.47	1.37	1.99
CO (lb/MMBtu)	0.39	0.43	0.41	0.57
CO (tons/yr)	21.4	23.7	22.5	27.4
THC (ppmvd @ 15% O2)	1446	1817	1624	2317
THC (lb/hr)	22.6	28.8	25.6	31.8
THC (g/BHP-hr)	5.93	7.79	6.82	10.2
THC (lb/MMBtu)	1.80	2.26	2.02	2.88
THC (tons/yr)	99.1	126	112	139

a Based on HHV
b Used in emission calculations.
Note: Two power outages occured during Run 9
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

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E4B-SUM.WK4

Table 4-6

Station CEM Results
Engine 4
C-B GMVC-10C

Test Period Load Condition Sampling Location Date Test Time	8 Full After Catalyst 8/26/94 1051-1226	10 Intermediate After Catalyst 8/26/94 1620-1821
Ambient Conditions		
Barometric Pressure (in. Hg)	29.47	29.45
Ambient Temperature (°F)	84	86
Relative Humidity (%)	47.8	42.6
Abs. Humidity (lb H2O/lb dry air)	12.5	11.8
Engine Operating Conditions		
Brake horsepower (BHP)	1773	1600
Load (%)	99	89
Engine Speed (rpm)	299	300
Fuel Flow (scf/min)	211	203
Heat Input (MMBtu/hr) (a)	12.6	12.1
Heat Rate (Btu/BHP-hr, HHV)	7199	7699
Heat Rate (Btu/BHP-hr, LHV)	6488	6938
NG HHV (Btu/scf)	1009	1009
NG LHV (Btu/scf)	910	910
Exhaust Gas Conditions		
Vol. Flow (dscfm) - M 2	8751	NA
Vol. Flow (dscfm) - M19, Fd (b)	6696	6592
Stack Gas Temperature (°F)	517	517
Moisture (%V)	7.26	7.30
O2 (%V)	15.4	15.5
CO2 (%V)	3.03	2.96
NOx (ppmvd)	44.0	33.1
CO (ppmvd)	14.2	12.7
THC (ppmvw)	1358	1567
Exhaust Emissions		
NOx (ppmvd @ 15% O2)	46.9	35.9
NOx (lb/hr)	2.11	1.56
NOx (g/BHP-hr)	0.54	0.44
NOx (lb/MMBtu)	0.17	0.13
NOx (tons/yr)	9.25	6.84
CO (ppmvd @ 15% O2)	15.1	13.8
CO (lb/hr)	0.41	0.37
CO (g/BHP-hr)	0.11	0.10
CO (lb/MMBtu)	0.03	0.03
CO (tons/yr)	1.81	1.60
THC (ppmvd @ 15% O2)	1559	1837
THC (lb/hr)	24.4	27.8
THC (g/BHP-hr)	6.25	7.87
THC (lb/MMBtu)	1.94	2.29
THC (tons/yr)	107	122

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-7

Station CEM Results
Engine 8
I-R KVS-412 (PCC)

Test Period	11	12
Load Condition	Intermediate	Intermediate
Date	8/27/94	8/27/94
Test Time	1108-1503	1639-1921
Ambient Conditions		
Barometric Pressure (in. Hg)	29.45	29.41
Ambient Temperature (°F)	91	86
Relative Humidity (%)	32.7	35.0
Abs. Humidity (lb H2O/lb dry air)	10.8	9.7
Engine Operating Conditions		
Brake horsepower (BHP)	1783	1640
Load (%)	89	82
Engine Speed (rpm)	330	330
Fuel Flow (scf/min)	272	253
Heat Input (MMBtu/hr) (a)	16.2	15.1
Heat Rate (Btu/BHP-hr, HHV)	9239	9340
Heat Rate (Btu/BHP-hr, LHV)	8327	8418
NG HHV (Btu/scf)	1009	1009
NG LHV (Btu/scf)	910	910
Exhaust Gas Conditions		
Vol. Flow (dscfm) - M 2	5726	5737
Vol. Flow (dscfm) - M19, Fd (b)	4975	4706
Stack Gas Temperature (°F)	741	719
Moisture (%V)	11.1	11.1
O2 (%V)	11.3	11.4
CO2 (%V)	5.36	5.22
NOx (ppmvd)	69.7	58.7
CO (ppmvd)	352	385
THC (ppmvw)	1937	3290
Exhaust Emissions		
NOx (ppmvd @ 15% O2)	42.8	36.6
NOx (lb/hr)	2.48	1.98
NOx (g/BHP-hr)	0.63	0.55
NOx (lb/MMBtu)	0.15	0.13
NOx (tons/yr)	10.9	8.7
CO (ppmvd @ 15% O2)	216	240
CO (lb/hr)	7.62	7.90
CO (g/BHP-hr)	1.94	2.19
CO (lb/MMBtu)	0.47	0.52
CO (tons/yr)	33.4	34.6
THC (ppmvd @ 15% O2)	1336	2308
THC (lb/hr)	27.0	43.4
THC (g/BHP-hr)	6.87	12.0
THC (lb/MMBtu)	1.66	2.87
THC (tons/yr)	118	190

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-8

Station CEM Results
Engine 9
I-R KVS

Test Period	13	14	17
Load Condition	Intermediate	Full	Full
Sampling Location	Before SCR	Before SCR	Before SCR
Date	8/28/94	8/29/94	8/29/94
Test Time	1254-1520	0858-0932	1613-1700
Ambient Conditions			
Barometric Pressure (in. Hg)	29.46	29.47	29.37
Ambient Temperature (°F)	94	77	91
Relative Humidity (%)	27.8	52.1	31.7
Abs. Humidity (lb H2O/lb dry air)	10.1	10.6	10.3
Engine Operating Conditions			
Brake horsepower (BHP)	1764	1840	1830
Load (%)	88	91	91
Engine Speed (rpm)	330	332	331
Fuel Flow (scf/min)	261	272	266
Heat Input (MMBtu/hr) (a)	15.6	16.3	15.9
Heat Rate (Btu/BHP-hr, HHV)	8950	8978	8821
Heat Rate (Btu/BHP-hr, LHV)	8068	8090	7948
NG HHV (Btu/scf)	1010	1011	1011
NG LHV (Btu/scf)	910	911	911
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	4181	4259	4259
Vol. Flow (dscfm) - M19, Fd (b)	3656	3914	3754
Stack Gas Temperature (°F)	779	779	779
Moisture (%V)	14.4	14.4	14.4
O2 (%V)	8.27	8.56	8.33
CO2 (%V)	6.95	6.93	7.10
NOx (ppmvd)	3351	3042	3339
CO (ppmvd)	138	141	126
THC (ppmvw)	947	938	900
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	1566	1454	1567
NOx (lb/hr)	87.7	85.2	89.7
NOx (g/BHP-hr)	22.6	21.0	22.3
NOx (lb/MMBtu)	5.64	5.24	5.65
NOx (tons/yr)	384	373	393
CO (ppmvd @ 15% O2)	64.3	67.6	59.1
CO (lb/hr)	2.19	2.41	2.06
CO (g/BHP-hr)	0.56	0.59	0.51
CO (lb/MMBtu)	0.14	0.15	0.13
CO (tons/yr)	9.6	10.6	9.02
THC (ppmvd @ 15% O2)	517	524	493
THC (lb/hr)	10.1	10.7	9.8
THC (g/BHP-hr)	2.59	2.63	2.44
THC (lb/MMBtu)	0.65	0.66	0.62
THC (tons/yr)	44.1	46.8	43.0

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-9

Station CEM Results
Engine 9
I-R KVS

Test Period	15	16
Load Condition	Full	Full
Sampling Location	After SCR	After SCR
Date	8/29/94	8/29/94
Test Time	0959-1330	1413-1549
Ambient Conditions		
Barometric Pressure (in. Hg)	29.45	29.39
Ambient Temperature (°F)	87	93
Relative Humidity (%)	33.1	31.8
Abs. Humidity (lb H2O/lb dry air)	9.3	11.2
Engine Operating Conditions		
Brake horsepower (BHP)	1809	1800
Load (%)	90	90
Engine Speed (rpm)	331	331
Fuel Flow (scf/min)	270	265
Heat Input (MMBtu/hr) (a)	16.1	15.8
Heat Rate (Btu/BHP-hr, HHV)	9051	8924
Heat Rate (Btu/BHP-hr, LHV)	8156	8041
NG HHV (Btu/scf)	1011	1011
NG LHV (Btu/scf)	911	911
Exhaust Gas Conditions		
Vol. Flow (dscfm) - M 2	4259	4259
Vol. Flow (dscfm) - M19, Fd (b)	3890	3804
Stack Gas Temperature (°F)	779	779
Moisture (%V)	14.4	14.4
O2 (%V)	8.60	8.56
CO2 (%V)	6.78	6.80
NOx (ppmvd)	677	775
CO (ppmvd)	103	102
THC (ppmvw)	949	1001
Exhaust Emissions		
NOx (ppmvd @ 15% O2)	325	371
NOx (lb/hr)	18.8	21.1
NOx (g/BHP-hr)	4.73	5.32
NOx (lb/MMBtu)	1.17	1.33
NOx (tons/yr)	82.5	92.5
CO (ppmvd @ 15% O2)	49.4	48.6
CO (lb/hr)	1.75	1.69
CO (g/BHP-hr)	0.44	0.42
CO (lb/MMBtu)	0.11	0.11
CO (tons/yr)	7.65	7.39
THC (ppmvd @ 15% O2)	532	559
THC (lb/hr)	10.7	11.1
THC (g/BHP-hr)	2.69	2.79
THC (lb/MMBtu)	0.67	0.70
THC (tons/yr)	47.0	48.5

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-10

Station CEM Results
Engine 8
I-R KVS

Test Period	A	B	C	D	E	F	G
Load/Timing	92%/8°	85%/8°	84%/5°	88%/5°	88%/8°	87%/11°	80%/11°
Date	8/30/94	8/30/94	8/30/94	8/30/94	8/30/94	8/30/94	8/30/94
Test Time	0745-0815	0903-0944	1013-1042	1100-1137	1150-1228	1234-1251	1307-1339
Ambient Conditions							
Barometric Pressure (in. Hg)	29.41	29.42	29.43	29.42	29.41	29.40	29.39
Ambient Temperature (°F)	73	78	82	85	86	89	90
Relative Humidity (%)	66.4	55.5	47.0	43.2	40.7	37.8	36.4
Abs. Humidity (lb H2O/lb dry air)	11.7	11.6	11.4	11.3	11.3	11.6	11.4
Engine Operating Conditions							
Brake horsepower (BHP)	1846	1693	1656	1708	1783	1687	1621
Load (%)	92	85	84	88	88	87	80
Engine Speed (rpm)	330	329	327	323	335	333	333
Fuel Flow (scf/min)	267	265	276	277	276	254	247
Heat Input (MMBtu/hr) (a)	15.9	15.8	16.5	16.5	16.5	15.1	14.7
Heat Rate (Btu/BHP-hr, HHV)	8757	9477	10094	9819	9375	9116	9226
Heat Rate (Btu/BHP-hr, LHV)	7893	8542	9098	8850	8450	8216	8315
NG HHV (Btu/scf)	1009	1009	1009	1009	1009	1009	1009
NG LHV (Btu/scf)	910	910	910	910	910	910	910
Exhaust Gas Conditions							
Vol. Flow (dscfm) - M 2	4531	4572	4553	4518	4517	4517	4579
Vol. Flow (dscfm) - M19, Fd (b)	4927	4978	5229	5143	5040	4582	4567
Stack Gas Temperature (°F)	746	739	756	766	762	749	733
Moisture (%V)	12.0	11.8	11.7	11.8	11.9	12.1	11.8
O2 (%V)	11.3	11.5	11.6	11.4	11.2	11.1	11.3
CO2 (%V)	5.19	5.06	5.01	5.13	5.23	5.30	5.12
NOx (ppmvd)	64.6	53.3	48.7	55.7	60.0	67.0	55.1
CO (ppmvd)	378	419	364	331	394	399	451
THC (ppmvw)	2333	3569	4143	2897	2683	1926	3298
Exhaust Emissions							
NOx (ppmvd @ 15% O2)	39.7	33.4	30.8	34.5	36.5	40.3	34.0
NOx (lb/hr)	2.28	1.90	1.82	2.05	2.17	2.20	1.80
NOx (g/BHP-hr)	0.56	0.51	0.50	0.54	0.55	0.59	0.50
NOx (lb/MMBtu)	0.14	0.12	0.11	0.12	0.13	0.15	0.12
NOx (tons/yr)	10.0	8.32	7.99	8.98	9.48	9.63	7.89
CO (ppmvd @ 15% O2)	232	263	230	205	240	240	278
CO (lb/hr)	8.10	9.10	8.29	7.42	8.65	7.96	8.98
CO (g/BHP-hr)	1.99	2.44	2.27	1.97	2.20	2.14	2.51
CO (lb/MMBtu)	0.51	0.58	0.50	0.45	0.53	0.53	0.61
CO (tons/yr)	35.5	39.8	36.3	32.5	37.9	34.9	39.3
THC (ppmvd @ 15% O2)	1631	2534	2964	2033	1854	1317	2305
THC (lb/hr)	32.5	50.2	61.1	42.1	38.2	25.0	42.5
THC (g/BHP-hr)	8.0	13.4	16.7	11.2	9.7	6.7	11.9
THC (lb/MMBtu)	2.04	3.17	3.71	2.55	2.32	1.65	2.89
THC (tons/yr)	142	220	268	184	167	109	186

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

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E8-PSUM.WK4

Table 4-11

FTIR Results
Waukesha L7042GU

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Waukesha L7042GU	Test 1 95% Load	NSCR Outlet	Methane	715	202	2.27	1.49	9.94
			Acetylene	ND	ND	—	—	—
			Ethylene	0.57	0.16	0.003	0.002	0.01
			Ethane	1.67	0.47	0.01	0.007	0.04
			Propylene	ND	ND	—	—	—
			Formaldehyde	ND	ND	—	—	—
			Methanol	3.14	0.89	0.02	0.01	0.09
			1,3 Butadiene	4.81	1.36	0.05	0.03	0.23
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	3.53	1.00	0.04	0.03	0.17
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Waukesha L7042GU	Test 2 92% Load	NSCR Outlet	Methane	742	210	2.36	1.59	10.32
			Acetylene	ND	ND	—	—	—
			Ethylene	0.60	0.17	0.003	0.002	0.01
			Ethane	1.91	0.54	0.01	0.008	0.05
			Propylene	ND	ND	—	—	—
			Formaldehyde	ND	ND	—	—	—
			Methanol	3.44	0.97	0.02	0.01	0.10
			1,3 Butadiene	4.98	1.41	0.05	0.04	0.23
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	4.90	1.39	0.05	0.04	0.24
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Waukesha L7042GU	Test 3 88% Load	Before NSCR	Methane	1019	294	3.23	2.28	14.16
			Acetylene	ND	ND	—	—	—
			Ethylene	35.3	10.2	0.20	0.14	0.86
			Ethane	16.4	4.74	0.10	0.07	0.43
			Propylene	ND	ND	—	—	—
			Formaldehyde	22.9	6.60	0.14	0.10	0.60
			Methanol	4.25	1.23	0.03	0.02	0.12
			1,3 Butadiene	3.50	1.01	0.04	0.03	0.16
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	2.56	0.74	0.04	0.03	0.19
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Waukesha L7042GU	Test 4 52% Load	Before NSCR	Methane	984	282	1.16	1.46	5.09
			Acetylene	ND	ND	—	—	—
			Ethylene	48.2	13.9	0.10	0.12	0.44
			Ethane	25.4	7.29	0.06	0.07	0.25
			Propylene	ND	ND	—	—	—
			Formaldehyde	24.3	6.96	0.05	0.07	0.24
			Methanol	4.26	1.22	0.01	0.01	0.04
			1,3 Butadiene	3.99	1.15	0.02	0.02	0.07
			Acetaldehyde	2.65	0.76	0.009	0.01	0.04
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	0.29	0.08	0.002	0.002	0.008
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

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Table 4-12

FTIR Results
Engine 1
C-B GMVA-10

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 1 C-B GMVA-10	Test 6 87% Load	Exhaust	Methane	664	622	—	—	—
			Acetylene	ND	ND	—	—	—
			Ethylene	2.95	2.76	—	—	—
			Ethane	13.0	12.2	—	—	—
			Propylene	3.99	3.74	—	—	—
			Formaldehyde	7.82	7.32	—	—	—
			Methanol	ND	ND	—	—	—
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.35	1.26	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

Note: Emission rates are not presented as no exhaust flowrate was calculated for this engine.

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Table 4-13

FTIR Results
Engine 4
C-B GMVA-10C

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 4 C-B GMVC-10C	Test 7 97% Load	Before CO Catalyst	Methane	1311	1433	22.6	5.92	99.0
			Acetylene	0.94	1.02	0.026	0.007	0.11
			Ethylene	8.14	8.90	0.25	0.064	1.08
			Ethane	24.5	26.8	0.79	0.21	3.47
			Propylene	4.17	4.56	0.19	0.05	0.83
			Formaldehyde	20.3	22.2	0.66	0.17	2.88
			Methanol	0.88	0.96	0.030	0.008	0.13
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 4 C-B GMVC-10C	Test 8 99% Load	After CO Catalyst	Methane	696	746	11.6	2.97	50.8
			Acetylene	ND	ND	—	—	—
			Ethylene	3.09	3.31	0.09	0.02	0.39
			Ethane	13.7	14.7	0.43	0.11	1.87
			Propylene	4.18	4.48	0.18	0.05	0.80
			Formaldehyde	8.19	8.79	0.26	0.07	1.12
			Methanol	ND	ND	—	—	—
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.41	1.52	0.08	0.02	0.36
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 4 C-B GMVC-10C	Test 9 93% Load	Before CO Catalyst	Methane	1432	1536	24.5	6.64	107
			Acetylene	0.92	0.99	0.03	0.007	0.11
			Ethylene	9.58	10.28	0.29	0.08	1.26
			Ethane	29.3	31.4	0.94	0.25	4.11
			Propylene	2.87	3.08	0.13	0.03	0.56
			Formaldehyde	22.0	23.6	0.71	0.19	3.09
			Methanol	0.35	0.38	0.01	0.003	0.05
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	1.64	1.76	0.08	0.02	0.34
			Acrolein	1.87	2.00	0.11	0.03	0.49
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 4 C-B GMVC-10C	Test 10 89% Load	After CO Catalyst	Methane	1404	1534	23.0	6.54	101
			Acetylene	0.65	0.71	0.02	0.005	0.08
			Ethylene	1.56	1.70	0.04	0.01	0.20
			Ethane	28.0	30.6	0.86	0.24	3.77
			Propylene	2.84	3.11	0.12	0.03	0.54
			Formaldehyde	4.81	5.25	0.15	0.04	0.65
			Methanol	ND	ND	—	—	—
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.40	1.53	0.08	0.02	0.35
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

NOTE: Two power outages occured during Run 9

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Table 4-13

(Continued)

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 4 C-B GMVC-10C	Test H 95% Load	Before CO Catalyst	Methane	1423	1499	23.5	6.26	103
			Acetylene	ND	ND	—	—	—
			Ethylene	5.83	6.14	0.17	0.04	0.74
			Ethane	28.1	29.6	0.87	0.23	3.81
			Propylene	9.80	10.3	0.42	0.11	1.86
			Formaldehyde	15.2	16.1	0.47	0.13	2.07
			Methanol	0.69	0.73	0.02	0.01	0.10
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.64	1.73	0.09	0.03	0.42
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 4 C-B GMVC-10C	Test I 79% Load	Before CO Catalyst	Methane	1840	2010	27.7	8.83	121
			Acetylene	ND	ND	—	—	—
			Ethylene	12.9	14.1	0.34	0.11	1.48
			Ethane	38.9	42.5	1.10	0.35	4.80
			Propylene	9.97	10.9	0.39	0.13	1.72
			Formaldehyde	25.5	27.9	0.72	0.23	3.15
			Methanol	0.99	1.08	0.03	0.01	0.13
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	2.53	2.76	0.13	0.04	0.58
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

Table 4-14

FTIR Results
Engine 8
I-R KVS

Engine	Test Period	Sample Location	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 8 I-R KVS	11	Exhaust	Methane	1761	1082	21.8	5.55	95.5
			Acetylene	2.35	1.45	0.05	0.01	0.21
			Ethylene	18.9	11.6	0.41	0.10	1.80
			Ethane	35.1	21.6	0.82	0.21	3.57
			Propylene	0.62	0.38	0.02	0.01	0.09
			Formaldehyde	33.4	20.5	0.78	0.20	3.40
			Methanol	1.47	0.90	0.04	0.01	0.16
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	4.03	2.47	0.14	0.03	0.60
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 8 I-R KVS	12	Exhaust	Methane	3550	2205	41.6	11.5	182
			Acetylene	2.12	1.32	0.04	0.01	0.18
			Ethylene	22.3	13.9	0.46	0.13	2.00
			Ethane	79.9	49.6	1.76	0.49	7.69
			Propylene	3.21	1.99	0.10	0.03	0.43
			Formaldehyde	45.8	28.4	1.01	0.28	4.41
			Methanol	2.30	1.43	0.05	0.01	0.24
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

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Table 4-15

FTIR Results
Engine 9
I-R KVS

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 9 I-R KVS	Test 17 91% Load	Before SCR Catalyst	Methane	885	415	8.28	2.05	36.2
			Acetylene	1.72	0.81	0.03	0.006	0.11
			Ethylene	2.64	1.24	0.04	0.01	0.19
			Ethane	14.1	6.60	0.25	0.06	1.08
			Propylene	17.1	7.99	0.42	0.10	1.83
			Formaldehyde	10.0	4.69	0.18	0.04	0.77
			Methanol	1.13	0.53	0.02	0.005	0.09
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	2.53	1.18	0.06	0.02	0.28
			Acrolein	ND	ND	—	—	—
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

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Table 4-16

Parametric FTIR Results
I-R KVS

Engine	Test Period	Sample Location	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 8 I-R KVS	Test A 92% Load 8° Timing	Exhaust	Methane	2289	1407	28.1	6.91	123
			Acetylene	1.09	0.67	0.02	0.01	0.10
			Ethylene	21.4	13.1	0.46	0.11	2.01
			Ethane	50.0	30.7	1.15	0.28	5.04
			Propylene	12.7	7.8	0.41	0.10	1.79
			Formaldehyde	41.4	25.5	0.95	0.23	4.17
			Methanol	2.05	1.26	0.05	0.01	0.22
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.61	0.99	0.07	0.02	0.30
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 8 I-R KVS	Test B 85% Load 8° Timing	Exhaust	Methane	3560	2234	44.1	11.8	193
			Acetylene	1.15	0.72	0.02	0.01	0.10
			Ethylene	24.7	15.5	0.53	0.14	2.34
			Ethane	83.7	52.5	1.95	0.52	8.52
			Propylene	14.4	9.0	0.47	0.13	2.05
			Formaldehyde	49.4	31.0	1.15	0.31	5.03
			Methanol	2.46	1.54	0.06	0.02	0.27
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.86	1.17	0.08	0.02	0.35
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 8 I-R KVS	Test C 84% Load 5° Timing	Exhaust	Methane	4130	2620	53.8	14.7	236
			Acetylene	1.21	0.77	0.03	0.01	0.11
			Ethylene	23.5	14.9	0.53	0.15	2.34
			Ethane	98.7	62.6	2.41	0.66	10.6
			Propylene	14.1	8.95	0.48	0.13	2.11
			Formaldehyde	48.2	30.6	1.18	0.32	5.15
			Methanol	2.57	1.63	0.07	0.02	0.29
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.66	1.05	0.08	0.02	0.33
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
Engine 8 I-R KVS	Test D 88% Load 5° Timing	Exhaust	Methane	2849	1770	36.5	9.70	160
			Acetylene	1.11	0.69	0.02	0.01	0.10
			Ethylene	21.0	13.1	0.47	0.13	2.06
			Ethane	64.1	39.8	1.54	0.41	6.74
			Propylene	13.5	8.38	0.45	0.12	1.99
			Formaldehyde	43.1	26.7	1.03	0.27	4.53
			Methanol	2.23	1.38	0.06	0.02	0.25
			1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	1.88	1.17	0.08	0.02	0.37
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

Table 4-16

(Continued)

Engine	Test Period	Sample Location	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
			Methane	2670	1624	33.5	8.53	147
			Acetylene	1.10	0.67	0.02	0.01	0.10
			Ethylene	22.9	13.9	0.50	0.13	2.20
			Ethane	58.7	35.7	1.38	0.35	6.05
			Propylene	13.2	8.03	0.43	0.11	1.90
Engine 8	Test E		Formaldehyde	45.6	27.8	1.07	0.27	4.70
I-R	88% Load	Exhaust	Methanol	2.25	1.37	0.06	0.01	0.25
KVS	8° Timing		1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	2.31	1.41	0.10	0.03	0.44
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
			Methane	2286	1376	26.1	7.02	114
			Acetylene	0.95	0.57	0.02	0.005	0.08
			Ethylene	22.7	13.7	0.45	0.12	1.99
			Ethane	47.7	28.7	1.02	0.27	4.47
			Propylene	13.3	8.00	0.40	0.11	1.74
Engine 8	Test F		Formaldehyde	44.3	26.7	0.95	0.26	4.15
I-R	87% Load	Exhaust	Methanol	2.08	1.25	0.05	0.01	0.21
KVS	8° Timing		1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	2.30	1.38	0.09	0.02	0.40
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—
			Methane	3284	2018	37.4	10.5	164
			Acetylene	1.16	0.71	0.02	0.01	0.09
			Ethylene	25.4	15.6	0.51	0.14	2.22
			Ethane	73.8	45.4	1.57	0.44	6.90
			Propylene	13.3	8.16	0.40	0.11	1.74
Engine 8	Test G		Formaldehyde	50.2	30.9	1.07	0.30	4.69
I-R	80% Load	Exhaust	Methanol	2.28	1.40	0.05	0.01	0.23
KVS	11° Timing		1,3 Butadiene	ND	ND	—	—	—
			Acetaldehyde	ND	ND	—	—	—
			Acrolein	2.40	1.48	0.10	0.03	0.42
			Benzene	ND	ND	—	—	—
			Cyclohexane	ND	ND	—	—	—
			Toluene	ND	ND	—	—	—
			m-Xylene	ND	ND	—	—	—

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Table 4-17

Gas Canister Results

Engine	Condition	Sample Location	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 4 C-B GMVC-10C	Test 9 93% Load	Before CO Catalyst	Benzene (HAP)	0.05	0.05	3.8E-03	1.0E-03	1.7E-02
			Toluene (HAP)	0.03	0.04	3.3E-03	9.0E-04	1.5E-02
			Ethyl Benzene (HAP)	ND	ND	—	—	—
			n-Hexane (HAP)	0.11	0.12	1.0E-02	2.7E-03	4.4E-02
			2,2,4-Trimethylpentane (HAP)	0.02	0.02	2.5E-03	6.8E-04	1.1E-02
			1,3-Butadiene (HAP)	0.03	0.03	1.6E-03	4.2E-04	6.9E-03
			Styrene (HAP)	ND	ND	—	—	—
			(m,o,p)-Xylene (HAP)	0.01	0.01	1.5E-03	4.0E-04	6.4E-03
			Cyclopentane	0.02	0.02	1.3E-03	3.6E-04	5.8E-03
			Methylcyclohexane	0.06	0.06	6.1E-03	1.6E-03	2.7E-02
			n-Octane	0.02	0.02	2.3E-03	6.2E-04	1.0E-02
			n-Pentane	0.30	0.32	2.2E-02	6.0E-03	9.7E-02
			Propane	8.16	8.75	3.7E-01	1.0E-01	1.6E+00
			n-Nonane	0.006	0.006	7.9E-04	2.1E-04	3.5E-03
			1,2,4-Trimethylbenzene	0.003	0.004	4.2E-04	1.2E-04	1.9E-03
			1,2,3-Trimethylbenzene	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	ND	ND	—	—	—
Engine 8 I-R KVS	Test 12 82% Load	Exhaust	Benzene (HAP)	0.05	0.03	2.8E-03	7.1E-04	1.2E-02
			Toluene (HAP)	0.04	0.02	2.7E-03	6.9E-04	1.2E-02
			Ethyl Benzene (HAP)	0.004	0.002	2.9E-04	7.3E-05	1.3E-03
			n-Hexane (HAP)	0.16	0.10	1.0E-02	2.6E-03	4.6E-02
			2,2,4-Trimethylpentane (HAP)	0.02	0.01	1.7E-03	4.3E-04	7.5E-03
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			Styrene (HAP)	ND	ND	—	—	—
			(m,o,p)-Xylene (HAP)	0.01	0.008	9.9E-04	[illegible]5E-04	4.4E-03
			Cyclopentane	0.03	0.02	1.3E-03	3.4E-04	5.9E-03
			Methylcyclohexane	0.08	0.05	6.2E-03	1.6E-03	2.7E-02
			n-Octane	0.02	0.01	2.0E-03	5.0E-04	8.7E-03
			n-Pentane	0.46	0.28	2.5E-02	6.3E-03	1.1E-01
			Propane	11.0	6.76	3.7E-01	9.3E-02	1.6E+00
			n-Nonane	0.007	0.004	6.8E-04	[illegible].7E-04	3.0E-03
			1,2,4-Trimethylbenzene	0.002	0.001	1.6E-04	4.2E-05	7.1E-04
			1,2,3-Trimethylbenzene	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	ND	ND	—	—	—
Engine 9 I-R KVS	Test 13 88% Load	Before SCR Catalyst	Benzene (HAP)	0.12	0.06	5.4E-03	1.4E-03	2.3E-02
			Toluene (HAP)	0.16	0.08	8.3E-03	2.1E-03	3.6E-02
			Ethyl Benzene (HAP)	0.01	0.007	8.7E-04	2.2E-04	3.8E-03
			n-Hexane (HAP)	0.76	0.36	3.6E-02	9.4E-03	1.6E-01
			2,2,4-Trimethylpentane (HAP)	0.08	0.04	5.3E-03	1.4E-03	2.3E-02
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			Styrene (HAP)	ND	ND	—	—	—
			(m,o,p)-Xylene (HAP)	0.04	0.02	2.6E-03	6.7E-04	1.1E-02
			Cyclopentane	0.11	0.05	4.4E-03	1.1E-03	1.9E-02
			Methylcyclohexane	0.45	0.21	2.4E-02	6.3E-03	1.1E-01
			n-Octane	0.11	0.05	6.7E-03	1.7E-03	2.9E-02
			n-Pentane	2.15	1.01	8.6E-02	2.2E-02	3.8E-01
			Propane	53.4	25.0	1.3E+00	3.4E-01	5.7E+00
			n-Nonane	0.03	0.01	2.0E-03	5.0E-04	8.6E-03
			1,2,4-Trimethylbenzene	0.004	0.002	2.4E-04	6.2E-05	1.0E-03
			1,2,3-Trimethylbenzene	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	0.008	0.004	5.2E-04	1.3E-04	2.3E-03
Engine 9 I-R KVS	Test 15 90% Load	After SCR Catalyst	Benzene (HAP)	0.12	0.06	5.3E-03	1.3E-03	2.3E-02
			Toluene (HAP)	0.15	0.07	8.4E-03	2.1E-03	3.7E-02
			Ethyl Benzene (HAP)	0.01	0.007	8.8E-04	2.2E-04	3.8E-03
			n-Hexane (HAP)	0.74	0.35	3.7E-02	9.4E-03	1.6E-01
			2,2,4-Trimethylpentane (HAP)	0.07	0.04	5.0E-03	1.3E-03	2.2E-02
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			Styrene (HAP)	ND	ND	—	—	—
			(m,o,p)-Xylene (HAP)	0.04	0.02	2.8E-03	6.9E-04	1.2E-02
			Cyclopentane	0.11	0.05	4.4E-03	1.1E-03	1.9E-02
			Methylcyclohexane	0.45	0.22	2.6E-02	6.6E-03	1.1E-01
			n-Octane	0.11	0.05	7.6E-03	1.9E-03	3.3E-02
			n-Pentane	2.03	0.97	8.6E-02	2.2E-02	3.8E-01
			Propane	54.3	26.0	1.4E+00	3.5E-01	6.2E+00
			n-Nonane	0.03	0.01	2.1E-03	5.3E-04	9.3E-03
			1,2,4-Trimethylbenzene	0.003	0.001	2.1E-04	5.3E-05	9.3E-04
			1,2,3-Trimethylbenzene	0.005	0.002	3.3E-04	8.4E-05	1.5E-03
			1,3,5-Trimethylbenzene	0.007	0.004	5.2E-04	1.3E-04	2.3E-03

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Table 4-18

Fuel Gas Canister Results
(ppmvd)

Pollutant	Engine 4 Run 9	Engine 8 Run 11	Engine 9 Run 13	Engine 9 Run 15	Average	% RSD
Benzene	9590	9570	10900	9110	9793	6.8
Toluene	13800	11200	14700	14000	13425	9.9
Ethyl Benzene	1130	552	917	1510	1027	33.8
n-Hexane	64200	61300	68000	60900	63600	4.5
2,2,4-Trimethylpentane	9260	6070	7500	6590	7355	16.5
1,3-Butadiene	ND	27.8	ND	ND	7	173.2
Styrene	ND	ND	ND	ND	ND	--
(m,o,p)-Xylene	5307	3114	4428	3520	4092	20.7
Cyclopentane	11300	9610	10400	9310	10155	7.6
Methylcyclohexane	38300	32300	41800	39500	37975	9.2
n-Octane	10400	7780	9240	9400	9205	10.2
n-Nonane	2890	2020	2310	2280	2375	13.4
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	--
1,2,3-Trimethylbenzene	ND	ND	ND	ND	ND	--
1,3,5-Trimethylbenzene	542	ND	ND	560	276	100.0

ND = not detected.

Table 4-19

Combustion Air and Crankcase Vent Canister Results

Pollutant	Engine 8 Combustion Air (ppbvd)	Engine 9 Crankcase Vent (ppbvd)
Benzene	16.3	827
Toluene	20.6	1400
Ethyl Benzene	2	99.6
n-Hexane	94.3	4530
2,2,4-Trimethylpentane	10.9	701
1,3-Butadiene	ND	ND
Styrene	ND	ND
(m,o,p)-Xylene	4.9	466.5
Cyclopentane	14.7	616
Methylcyclohexane	50.1	4440
n-Octane	13	1150
n-Nonane	3.3	265
1,2,4-Trimethylbenzene	ND	ND
1,2,3-Trimethylbenzene	ND	ND
1,3,5-Trimethylbenzene	ND	50.1

ND = not detected.

Table 4-20

GC Results

Engine	Test Period	Sample Location	Pollutant	Stack Conc. (ppmvw)	Conc. (ppmvd @15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 4 C-B GMVC-10C	Test 7 97% Load	Before CO Catalyst	Methane	**	—	—	—	—
			Ethane	40.5	47.7	1.41	0.370	6.18
			C3 as Propane	18.3	21.6	0.937	0.245	4.10
			C4 as Butane	14.3	16.9	0.964	0.253	4.22
			C5 as Pentane	13.6	16.0	1.14	0.297	4.97
			C6 as Hexane	12.1	14.2	1.20	0.315	5.27
			C2-C6 as CH4	98.8	116	1.84	0.481	8.04
Engine 4 C-B GMVC-10C	Test 9 93% Load	Before CO Catalyst	Methane	**	—	—	—	—
			Ethane	41.9	48.5	1.45	0.392	6.34
			C3 as Propane	10.3	11.9	0.522	0.141	2.28
			C4 as Butane	7.21	8.34	0.482	0.131	2.11
			C5 as Pentane	6.66	7.70	0.553	0.150	2.42
			C6 as Hexane	6.89	7.97	0.683	0.185	2.99
			C2-C6 as CH4	72.91	84.4	1.34	0.364	5.89
Engine 8 I-R KVS	Test 11 89% Load		Methane	**	—	—	—	—
			Ethane	53.64	37.1	1.40	0.357	6.14
			C3 as Propane	9.02	6.24	0.346	0.088	1.51
			C4 as Butane	3.80	2.63	0.192	0.049	0.841
			C5 as Pentane	2.76	1.91	0.173	0.044	0.758
			C6 as Hexane	2.51	1.73	0.188	0.048	0.823
			C2-C6 as CH4	71.7	49.6	0.999	0.254	4.38
Engine 8 I-R KVS	Test 12 82% Load		Methane	**	—	—	—	—
			Ethane	94.7	66.2	2.34	0.648	10.3
			C3 as Propane	14.7	10.3	0.532	0.147	2.33
			C4 as Butane	3.53	2.47	0.169	0.047	0.740
			C5 as Pentane	1.62	1.13	0.096	0.027	0.420
			C6 as Hexane	1.45	1.02	0.103	0.028	0.451
			C2-C6 as CH4	116	81.1	1.53	0.423	6.70
Engine 9 I-R KVS	Test 13 88% Load	Before SCR Catalyst	Methane	**	—	—	—	—
			Ethane	24.9	13.6	0.497	0.128	2.18
			C3 as Propane	4.29	2.35	0.126	0.032	0.550
			C4 as Butane	1.04	0.569	0.040	0.010	0.176
			C5 as Pentane	0.583	0.319	0.028	0.007	0.122
			C6 as Hexane	1.42	0.777	0.081	0.021	0.356
			C2-C6 as CH4	32.3	17.7	0.343	0.088	1.50
Engine 9 I-R KVS	Test 15 90% Load	After SCR Catalyst	Methane	**	—	—	—	—
			Ethane	27.5	15.4	0.583	0.146	2.55
			C3 as Propane	4.81	2.70	0.150	0.038	0.656
			C4 as Butane	1.77	0.993	0.073	0.018	0.318
			C5 as Pentane	NA	NA	NA	NA	NA
			C6 as Hexane	NA	NA	NA	NA	NA
			C2-C6 as CH4	NA	NA	NA	NA	NA

** Methane measurements unavailable due to instrument malfunction.

Table 4-21

CARB Method 430 Summary

Engine	Condition	Sample Location	Pollutant	Stack Conc. (ppmvd)	Stack Conc. (ppmvd @15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Waukesha L7042GU	Test 2 92% Load	NSCR Outlet	Formaldehyde	0.05	0.01	3.0E-04	2.0E-04	1.3E-03
			Acetaldehyde	0.03	0.008	2.6E-04	1.8E-04	1.1E-03
			Acrolein	ND	—	—	—	—
			Butyrald/Isobutyraldehyde	0.01	0.003	1.4E-04	9.7E-05	6.3E-04
Waukesha L7042GU	Test 3 88% Load	NSCR Inlet	Formaldehyde	20.0	5.75	1.2E-01	8.4E-02	5.2E-01
			Acetaldehyde	0.42	0.12	3.7E-03	2.6E-03	1.6E-02
			Acrolein	0.06	0.02	6.7E-04	4.7E-04	2.9E-03
			Butyrald/Isobutyraldehyde	0.03	0.009	4.3E-04	3.0E-04	1.9E-03
Engine 4 C-B GMVC-10C	Test 7 97% Load	Before CO Catalyst	Formaldehyde	21.3	23.2	6.9E-01	1.8E-01	3.0E+00
			Acetaldehyde	0.58	0.63	2.7E-02	7.2E-03	1.2E-01
			Acrolein	0.01	0.01	6.0E-04	1.6E-04	2.6E-03
			Butyrald/Isobutyraldehyde	0.03	0.03	2.3E-03	6.1E-04	1.0E-02
Engine 4 C-B GMVC-10C	Test 8 99% Load	After CO Catalyst	Formaldehyde	2.39	2.56	7.5E-02	1.9E-02	3.3E-01
			Acetaldehyde	0.21	0.23	9.6E-03	2.5E-03	4.2E-02
			Acrolein	0.01	0.01	5.8E-04	1.5E-04	2.6E-03
			Butyrald/Isobutyraldehyde	0.02	0.02	1.5E-03	3.8E-04	6.6E-03
Engine 4 C-B GMVC-10C	Test 10 89% Load	After CO Catalyst	Formaldehyde	3.05	3.33	9.4E-02	2.7E-02	4.1E-01
			Acetaldehyde	0.22	0.24	9.9E-03	2.8E-03	4.3E-02
			Acrolein	0.004	0.005	2.5E-04	7.2E-05	1.1E-03
			Butyrald/Isobutyraldehyde	0.02	0.02	1.5E-03	4.3E-04	6.6E-03
Engine 8 I-R KVS	Test 11 89% Load	Exhaust	Formaldehyde	34.6	21.3	8.0E-01	2.0E-01	3.5E+00
			Acetaldehyde	0.45	0.28	1.5E-02	3.9E-03	6.7E-02
			Acrolein	0.01	0.006	4.3E-04	1.1E-04	1.9E-03
			Butyrald/Isobutyraldehyde	0.02	0.01	1.1E-03	2.8E-04	4.9E-03
Engine 8 I-R KVS	Test 12 82% Load	Exhaust	Formaldehyde	35.3	21.9	7.8E-01	2.1E-01	3.4E+00
			Acetaldehyde	0.19	0.12	6.1E-03	1.7E-03	2.7E-02
			Acrolein	0.02	0.01	8.2E-04	2.3E-04	3.6E-03
			Butyrald/Isobutyraldehyde	0.06	0.04	3.2E-03	8.8E-04	1.4E-02
Engine 9 I-R KVS	Test 13 88% Load	Before SCR Inlet	Formaldehyde	0.28	0.13	4.8E-03	1.2E-03	2.1E-02
			Acetaldehyde	0.03	0.01	7.5E-04	1.9E-04	3.3E-03
			Acrolein	ND	—	—	—	—
			Butyrald/Isobutyraldehyde	0.01	0.005	4.1E-04	1.1E-04	1.8E-03
Engine 9 I-R KVS	Test 15 90% Load	After SCR Outlet	Formaldehyde	0.27	0.13	4.9E-03	1.2E-03	2.1E-02
			Acetaldehyde	0.13	0.06	3.5E-03	8.7E-04	1.5E-02
			Acrolein	0.0006	0.0003	2.0E-05	5.1E-06	8.9E-05
			Butyrald/Isobutyraldehyde	0.04	0.02	1.7E-03	4.4E-04	7.6E-03

Table 4-22

CARB Method 429 Results

Engine	Condition	Sample Location	Pollutant	Stack Conc. (ng/dscf)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Waukesha L7042GU	Test 2 92% Load	After NSCR Catalyst	Naphthalene	135	2.3E-05	1.5E-05	1.0E-04
			2-Methylnaphthalene	16.7	2.8E-06	1.9E-06	1.2E-05
			Acenaphthylene	7.40	1.2E-06	8.4E-07	5.5E-06
			Acenaphthene	1.25	2.1E-07	1.4E-07	9.2E-07
			Fluorene	5.31	8.9E-07	6.1E-07	3.9E-06
			Phenanthrene	25.0	4.2E-06	2.8E-06	1.8E-05
			Anthrancene	5.21	8.8E-07	5.9E-07	3.8E-06
			Fluoranthene	4.79	8.1E-07	5.5E-07	3.5E-06
			Pyrene	4.90	8.2E-07	5.6E-07	3.6E-06
			Benz(a)anthrancene	1.25	2.1E-07	1.4E-07	9.2E-07
			Chrysene	1.35	2.3E-07	1.5E-07	1.0E-06
			Benzo(b)fluoranthene	1.02	1.7E-07	1.2E-07	7.5E-07
			Benzo(k)fluoranthene	0.40	6.7E-08	4.5E-08	2.9E-07
			Benzo(e)pyrene	0.59	1.0E-07	6.8E-08	4.4E-07
			Benzo(a)pyrene	0.33	5.6E-08	3.8E-08	2.5E-07
			Perylene	0.08	1.4E-08	9.4E-09	6.1E-08
			Indeno(1,2,3-c,d)pyrene	0.20	3.3E-08	2.3E-08	1.5E-07
			Dibenz(a,h)anthracene	0.10	1.7E-08	1.1E-08	7.4E-08
			Benzo(g,h,i)perylene	0.34	5.8E-08	3.9E-08	2.5E-07
Engine 4 C-B GMVC-10C	Test 9 93% Load	Before CO Catalyst	Naphthalene	26.1	2.4E-05	6.4E-06	1.0E-04
			2-Methylnaphthalene	6.52	5.9E-06	1.6E-06	2.6E-05
			Acenaphthylene	1.46	1.3E-06	3.6E-07	5.8E-06
			Acenaphthene	0.48	4.4E-07	1.2E-07	1.9E-06
			Fluorene	0.84	7.7E-07	2.1E-07	3.4E-06
			Phenanthrene	2.84	2.6E-06	7.0E-07	1.1E-05
			Anthrancene	0.31	2.9E-07	7.7E-08	1.3E-06
			Fluoranthene	0.92	8.4E-07	2.3E-07	3.7E-06
			Pyrene	1.38	1.3E-06	3.4E-07	5.5E-06
			Benz(a)anthrancene	0.12	1.1E-07	3.0E-08	4.9E-07
			Chrysene	0.25	2.3E-07	6.2E-08	1.0E-06
			Benzo(b)fluoranthene	0.12	1.0E-07	2.8E-08	4.6E-07
			Benzo(k)fluoranthene	0.06	5.0E-08	1.4E-08	2.2E-07
			Benzo(e)pyrene	0.33	3.0E-07	8.1E-08	1.3E-06
			Benzo(a)pyrene	0.08	7.7E-08	2.1E-08	3.4E-07
			Perylene	0.07	6.0E-08	1.6E-08	2.6E-07
			Indeno(1,2,3-c,d)pyrene	0.14	1.3E-07	3.4E-08	5.5E-07
			Dibenz(a,h)anthracene	ND	—	—	—
			Benzo(g,h,i)perylene	0.35	3.2E-07	8.7E-08	1.4E-06

Table 4-22

(Continued)

Engine	Condition	Sample Location	Pollutant	Stack Conc. (ng/dscf)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 8 I-R KVS	Test 11 89% Load	Exhaust	Naphthalene	102	6.7E-05	1.7E-05	2.9E-04
			2-Methylnaphthalene	25.3	1.7E-05	4.2E-06	7.3E-05
			Acenaphthylene	3.90	2.6E-06	6.5E-07	1.1E-05
			Acenaphthene	0.98	6.5E-07	1.6E-07	2.8E-06
			Fluorene	1.79	1.2E-06	3.0E-07	5.2E-06
			Phenanthrene	5.59	3.7E-06	9.4E-07	1.6E-05
			Anthrancene	0.59	3.9E-07	9.9E-08	1.7E-06
			Fluoranthene	0.80	5.3E-07	1.3E-07	2.3E-06
			Pyrene	1.04	6.9E-07	1.7E-07	3.0E-06
			Benz(a)anthrancene	0.20	1.3E-07	3.4E-08	5.8E-07
			Chrysene	0.47	3.1E-07	7.9E-08	1.4E-06
			Benzo(b)fluoranthene	0.09	5.8E-08	1.5E-08	2.6E-07
			Benzo(k)fluoranthene	ND	—	—	—
			Benzo(e)pyrene	0.21	1.4E-07	3.5E-08	6.1E-07
			Benzo(a)pyrene	ND	—	—	—
			Perylene	ND	—	—	—
			Indeno(1,2,3-c,d)pyrene	ND	—	—	—
			Dibenz(a,h)anthracene	ND	—	—	—
			Benzo(g,h,i)perylene	0.19	1.2E-07	3.2E-08	5.5E-07
Engine 9 I-R KVS	Test 15 90% Load	After SCR Catalyst	Naphthalene	ND	—	—	—
			2-Methylnaphthalene	0.77	4.0E-07	9.9E-08	1.7E-06
			Acenaphthylene	0.56	2.9E-07	7.3E-08	1.3E-06
			Acenaphthene	0.08	4.1E-08	1.0E-08	1.8E-07
			Fluorene	0.47	2.4E-07	6.1E-08	1.1E-06
			Phenanthrene	ND	—	—	—
			Anthrancene	0.14	7.4E-08	1.9E-08	3.2E-07
			Fluoranthene	0.23	1.2E-07	2.9E-08	5.1E-07
			Pyrene	0.16	8.4E-08	2.1E-08	3.7E-07
			Benz(a)anthrancene	ND	—	—	—
			Chrysene	0.26	1.3E-07	3.3E-08	5.8E-07
			Benzo(b)fluoranthene	ND	—	—	—
			Benzo(k)fluoranthene	ND	—	—	—
			Benzo(e)pyrene	ND	—	—	—
			Benzo(a)pyrene	ND	—	—	—
			Perylene	ND	—	—	—
			Indeno(1,2,3-c,d)pyrene	ND	—	—	—
			Dibenz(a,h)anthracene	ND	—	—	—
			Benzo(g,h,i)perylene	ND	—	—	—

Table 4-23

PM-10 Results

Engine	Condition	Sample Location	Pollutant	Stack Conc. (gr/dscf)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Waukesha L7042GU	Test 1 95% Load	After NSCR Catalyst	PM-10	0.0006	0.004	0.002	0.02
			Organic Condensible PM	0.006	0.04	0.03	0.17
			Inorganic Condensible PM	0.004	0.02	0.02	0.11
Engine 4 C-B GMVC-10C	Test 10 89% Load	After CO Catalyst	PM-10	0.0001	0.007	0.002	0.03
			Organic Condensible PM	0.005	0.31	0.09	1.35
			Inorganic Condensible PM	0.00099	0.06	0.02	0.25
Engine 8 I-R KVS	Test 12 82% Load	Exhaust	PM-10	0.0001	0.004	0.001	0.02
			Organic Condensible PM	0.003	0.12	0.03	0.53
			Inorganic Condensible PM	0.003	0.11	0.03	0.47
Engine 9 I-R KVS	Test 16 [1] 90% Load	After SCR Catalyst	PM-10	ND	—	—	—
			Organic Condensible PM	NA	—	—	—
			Inorganic Condensible PM	NA	—	—	—

[1] A negative filter weight gain was measured for Test Period 16, possibly caused by difficulties in recovering the filter after completion of sampling. In addition, the impingers associated with this run broke after sampling and could not be recovered for condensibles determination.

Campaign 6 Tables

Table 4-3

FTIR Summary
Clark BA-5 (Engine 10)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 10 Clark BA-5	Test 1 94% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	18.0	15.8	0.36	0.19	1.57
		Ethylene	8.22	7.24	0.15	0.08	0.67
		Formaldehyde (HAP)	18.6	16.4	0.37	0.20	1.62
		Methane	755	665	8.03	4.28	35.2
		Methanol (HAP)	1.39	1.22	0.03	0.02	0.13
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 10 Clark BA-5	Test 2 100% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	2.20	1.96	0.07	0.04	0.31
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	22.3	19.9	0.49	0.24	2.13
		Ethylene	8.21	7.33	0.17	0.08	0.73
		Formaldehyde (HAP)	17.9	16.0	0.39	0.20	1.71
		Methane	925	827	10.8	5.37	47.2
		Methanol (HAP)	1.61	1.44	0.04	0.02	0.16
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 10 Clark BA-5	Test 3 80% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	29.2	28.7	0.59	0.37	2.60
		Ethylene	9.38	9.22	0.18	0.11	0.78
		Formaldehyde (HAP)	23.0	22.6	0.47	0.29	2.05
		Methane	1089	1070	11.8	7.39	51.7
		Methanol (HAP)	1.35	1.32	0.03	0.02	0.13
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

* FTIR concentration corrected to dry by Method 4 H2O value

Table 4-4

Canister Analysis
Clark BA-5 (Engine 10)

Engine		Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 10 Clark BA-5	2	Test 2 100% Load	1,2,3-Trimethylbenzene	ND	ND	—	—	—
			1,2,4-Trimethylbenzene	0.007	0.006	6.1E-04	3.1E-04	2.7E-03
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	ND	ND	—	—	—
			2,2,4-Trimethylpentane (HAP)	0.03	0.03	2.5E-03	1.2E-03	1.1E-02
			Acetylene	ND	ND	—	—	—
			Benzene (HAP)	0.21	0.19	1.2E-02	6.0E-03	5.2E-02
			Butane	0.54	0.48	2.3E-02	1.1E-02	1.0E-01
			Cyclohexane	0.03	0.03	1.8E-03	9.2E-04	8.1E-03
			Cyclopentane	0.008	0.007	4.1E-04	2.0E-04	1.8E-03
			Ethane	32.9	29.4	7.2E-01	3.6E-01	3.2E+00
			Ethyl Benzene (HAP)	0.006	0.005	4.6E-04	2.3E-04	2.0E-03
			Ethylene	ND	ND	—	—	—
			n-Hexane (HAP)	0.05	0.04	3.1E-03	1.6E-03	1.4E-02
			Isobutane	0.47	0.42	2.0E-02	9.9E-03	8.7E-02
			Methanol (HAP)	ND	ND	—	—	—
			Methylcyclohexane	0.02	0.02	1.4E-03	7.1E-04	6.3E-03
			n-Nonane	ND	ND	—	—	—
			n-Octane	0.003	0.003	2.5E-04	1.2E-04	1.1E-03
			n-Pentane	0.14	0.13	7.5E-03	3.7E-03	3.3E-02
			Propane	4.70	4.20	1.5E-01	7.5E-02	6.6E-01
			Propylene	ND	ND	—	—	—
			Styrene (HAP)	0.005	0.004	3.8E-04	1.9E-04	1.7E-03
			Toluene (HAP)	0.08	0.07	5.4E-03	2.7E-03	2.4E-02
			(m,p,o)-Xylene (HAP)	0.01	0.01	7.7E-04	3.9E-04	3.4E-03

Table 4-5

GC Results
Clark BA-5 (Engine 10)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 10 Clark BA-5	Test 1 94% Load	Methane	531	522	6.32	3.37	27.7
		Ethane	7.82	7.69	0.17	0.09	0.76
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	15.6	15.4	0.19	0.10	0.82
Engine 10 Clark BA-5	Test 2 100% Load	Methane	680	661	8.63	4.31	37.8
		Ethane	13.50	13.1	0.32	0.16	1.41
		Propane	0.54	0.52	0.02	0.01	0.08
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	28.6	27.8	0.36	0.18	1.59
Engine 10 Clark BA-5	Test 3 80% Load	Methane	760	819	9.06	5.67	39.7
		Ethane	15.80	17.0	0.35	0.22	1.55
		Propane	4.81	5.19	0.16	0.10	0.69
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	46.0	49.6	0.55	0.34	2.40

Table 4-6

CARB Method 430 Results
Clark BA-5 (Engine 10)

Engine	Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 10 Clark BA-5	Test 2 100% Load	Formaldehyde (HAP)	17.9	16.0	3.9E-01	2.0E-01	1.7E+00
		Acetaldehyde (HAP)	2.05	1.83	6.6E-02	3.3E-02	2.9E-01
		Acrolein (HAP)	0.24	0.21	9.8E-03	4.9E-03	4.3E-02
		Butyrald/Isobutyraldehyde	0.29	0.26	1.5E-02	7.6E-03	6.7E-02
		Propanal	0.28	0.25	1.2E-02	5.9E-03	5.2E-02
Engine 10 Clark BA-5	Test 3 80% Load	Formaldehyde (HAP)	19.9	19.6	4.0E-01	2.5E-01	1.8E+00
		Acetaldehyde (HAP)	1.11	1.09	3.3E-02	2.1E-02	1.5E-01
		Acrolein (HAP)	0.20	0.20	7.6E-03	4.8E-03	3.3E-02
		Butyrald/Isobutyraldehyde	0.03	0.03	1.5E-03	9.2E-04	6.4E-03
		Propanal	0.10	0.10	3.9E-03	2.5E-03	1.7E-02

Table 4-7

Oprating Conditions and CEM Results
Clark HBA-5 (Engine 12)

Test Period	**4**	**5**
Load Condition	**Low**	**Intermediate**
Sampling Location	**Exhaust**	**Exhaust**
Date	**11/04/94**	**11/05/94**
Test Time	**1702-1832**	**1345-1802**
Ambient Conditions		
Barometric Pressure (in. Hg)	26.37	26.47
Ambient Temperature (°F)	51	71
Relative Humidity (%)	92.3	23.2
Abs. Humidity (lb H2O/1000 lb dry air)	8.0	4.3
Engine Operating Conditions		
Brake horsepower (BHP)	741	839
Load (%)	75	84
Engine Speed (rpm)	297	301
Fuel Flow (scf/min)	140	150
Heat Input (MMBtu/hr) (a)	8.5	9.0
Heat Rate (Btu/BHP-hr, HHV)	11612	10947
Heat Rate (Btu/BHP-hr, LHV)	10516	9912
NG HHV (Btu/scf)	1025	1021
NG LHV (Btu/scf)	928	924
Exhaust Gas Conditions		
Vol. Flow (dscfm) - M2	4502	4473
Vol. Flow (dscfm) - M19, Fd (b)	4759	4617
Stack Gas Temperature (°F)	540	592
Moisture (%V)	6.8	6.9
O2 (%V dry)	15.7	15.1
CO2 (%V dry)	3.3	3.7
NOx (ppmvd)	496	1030
CO (ppmvd)	228	198
THC (ppmvw) (c)	NA	1327
Exhaust Emissions		
NOx (ppmvd @ 15% O2)	559	1053
NOx (lb/hr)	16.9	34.0
NOx (g/BHP-hr)	10.3	18.4
NOx (lb/MMBtu)	1.99	3.76
NOx (tons/yr)	74.0	149
CO (ppmvd @ 15% O2)	258	202
CO (lb/hr)	4.73	3.97
CO (g/BHP-hr)	2.90	2.15
CO (lb/MMBtu)	0.56	0.44
CO (tons/yr)	20.7	17.4
THC (ppmvd @ 15% O2)	–	1457
THC (lb/hr)	–	16.4
THC (g/BHP-hr)	–	8.86
THC (lb/MMBtu)	–	1.81
THC (tons/yr)	–	71.8

a Based on HHV
b Used in emission calculations.
c THC analyzer equipment failure. A new instrument arrived on site late on 11/04/94.
NA = Not available
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-8

FTIR Results
Clark HBA-5 (Engine 12)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 12 Clark HBA-5	Test 4 75% Load	1,3-Butadiene (HAP)	ND	---	---	---	---
		Acetaldehyde (HAP)	ND	---	---	---	---
		Acetylene	1.21	1.37	0.02	0.01	0.10
		Acrolein (HAP)	2.25	2.55	0.09	0.06	0.41
		Benzene (HAP)	ND	---	---	---	---
		Cyclohexane	1.14	1.29	0.07	0.04	0.31
		Ethane	49.8	56.5	1.11	0.68	4.85
		Ethylene	15.0	17.1	0.31	0.19	1.37
		Formaldehyde (HAP)	33.3	37.7	0.74	0.45	3.24
		Methane	1910	2167	22.6	13.9	99
		Methanol (HAP)	1.53	1.74	0.04	0.02	0.16
		m-Xylene (HAP)	ND	---	---	---	---
		Propylene	ND	---	---	---	---
		Toluene (HAP)	ND	---	---	---	---
Engine 12 Clark HBA-5	Test 5 84% Load	1,3-Butadiene (HAP)	ND	---	---	---	---
		Acetaldehyde (HAP)	3.34	3.39	0.11	0.06	0.46
		Acetylene	1.38	1.40	0.03	0.01	0.11
		Acrolein (HAP)	2.55	2.60	0.10	0.06	0.45
		Benzene (HAP)	ND	---	---	---	---
		Cyclohexane	0.71	0.72	0.04	0.02	0.19
		Ethane	32.9	33.5	0.71	0.38	3.11
		Ethylene	13.6	13.9	0.27	0.15	1.20
		Formaldehyde (HAP)	26.6	27.0	0.57	0.31	2.51
		Methane	1284	1306	14.8	7.98	64.7
		Methanol (HAP)	1.44	1.47	0.03	0.02	0.15
		m-Xylene (HAP)	ND	---	---	---	---
		Propylene	ND	---	---	---	---
		Toluene (HAP)	ND	---	---	---	---

Table 4-9

GC Results
Clark HBA-5 (Engine 12)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 12 Clark HBA-5	Test 4 75% Load	Methane	1393	1696	17.8	10.9	77.8
		Ethane	33.4	40.6	0.80	0.49	3.49
		Propane	4.61	5.61	0.16	0.10	0.71
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	80.6	98.1	1.03	0.63	4.50
Engine 12 Clark HBA-5	Test 5 84% Load	Methane	961	1050	11.9	6.44	52.1
		Ethane	21.4	23.4	0.50	0.27	2.18
		Propane	2.81	3.07	0.10	0.05	0.42
		Butane	ND	—	—	—	—
		Pentane	0.11	0.12	0.006	0.003	0.03
		C2 - C5 as Methane	51.8	56.6	0.64	0.35	2.81

Table 4-10

SW-846 Method 0010 Results
Clark HBA-5 (Engine 12)

Engine	Condition	Pollutant	Conc. (µg/dscf)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 12 Clark HBA-5	Test 5 84% Load	Acenaphthene	0.05	3.2E-05	1.7E-05	1.4E-04
		Acenaphthylene	0.12	7.4E-05	4.0E-05	3.3E-04
		Anthracene	0.03	1.8E-05	9.6E-06	7.8E-05
		Benzo(a)anthracene	0.01	8.0E-06	4.3E-06	3.5E-05
		Benzo(a)pyrene	ND	—	—	—
		Benzo(e)pyrene	ND	—	—	—
		Benzo(b)fluoranthene	ND	—	—	—
		Benzo(g,h,i)perylene	ND	—	—	—
		Benzo(k)fluoranthene	ND	—	—	—
		Biphenyl	0.09	5.5E-05	3.0E-05	2.4E-04
		Chrysene	0.02	1.4E-05	7.6E-06	6.2E-05
		Dibenz(a,h)anthracene	ND	—	—	—
		Fluoranthene	0.01	6.0E-06	3.2E-06	2.6E-05
		Fluorene	0.07	4.3E-05	2.4E-05	1.9E-04
		Indeno(1,2,3-c,d)pyrene	ND	—	—	—
		2-Methylnaphthalene	0.78	4.7E-04	2.6E-04	2.1E-03
		Naphthalene	1.69	1.0E-03	5.6E-04	4.5E-03
		Perylene	ND	—	—	—
		Phenanthrene	0.14	8.6E-05	4.6E-05	3.8E-04
		Phenol	1.07	6.5E-04	3.5E-04	2.9E-03
		Pyrene	0.02	1.1E-05	6.1E-06	4.9E-05

Table 4-11

Operating Conditions and CEM Results
Solar Taurus T6502

Test Period	6	7	8
Load Condition	Full	Full	Low
Sampling Location	Exhaust	Exhaust	Exhaust
Date	11/07/94	11/08/94	11/08/94
Test Time	1709-1823	0915-1344	1700-1912
Ambient Conditions			
Barometric Pressure (in. Hg)	26.51	26.50	26.47
Ambient Temperature (°F)	69	76	67
Relative Humidity (%)	44.2	47.2	45.6
Abs. Humidity (lb H2O/1000 lb dry air)	7.5	10.4	7.2
Turbine Operating Conditions			
Brake Horsepower (BHP)	4803	4709	3934
Percent Load (%)	95	95	77
T5 Temperature (°F)	1401	1400	1305
Power Turbine Speed (rpm)	12458	12250	11567
Compressor Suction (psig)	463.7	478.3	471.8
Compressor Discharge (psig)	645.1	658.1	627.2
Suction Temperature (°F)	76.5	76.8	79.1
Discharge Temperature (°F)	130.3	129.0	125.4
Fuel Flow (scf/min)	709.3	745.0	600.7
Heat Input (MMBtu/hr)	42.8	45.0	36.2
Heat Rate (Btu/BHP-hr, HHV)	9040	9691	9355
Heat Rate (Btu/BHP-hr, LHV)	8187	8781	8475
NG HHV(Btu/scf)	1020	1021	1021
NG LHV (Btu/scf)	924	925	925
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	29192	30964	27544
Vol. Flow (dscfm) - M19, Fd	25757	26581	23311
Stack Gas Temperature (°F)	954	941	902
Moisture (%V)	6.4	6.5	6.1
O2 (%V dry)	16.0	15.9	16.3
CO2 (%V dry)	3.2	3.2	2.9
NOx (ppmvd)	71.5	70.8	56.0
CO (ppmvd)	ND	ND	ND
THC (ppmvw)	ND	ND	ND
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	86.5	84.1	72.3
NOx ISO (ppmvd @ 15% O2)	91.3	91.8	76.4
NOx (lb/hr)	13.2	13.5	9.3
NOx (g/bhp-hr)	1.2	1.3	1.1
NOx (lb/MMBtu)	0.3	0.3	0.3
NOx (tons/yr)	57.8	59.0	40.9
CO (ppmvd @ 15% O2)	—	—	—
CO (lb/hr)	—	—	—
CO (g/bhp-hr)	—	—	—
CO (lb/MMBtu)	—	—	—
CO (tons/yr)	—	—	—
THC (ppmvd @ 15% O2)	—	—	—
THC (lb/hr)	—	—	—
THC (g/bhp-hr)	—	—	—
THC (lb/MMBtu)	—	—	—
THC (tons/yr)	—	—	—

Note: Emission rates are based on the M-19 volumetric flowrate.
Turbine load is based on available load at ambient conditions during testing.
Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-12

FTIR Results
Solar Taurus T6502

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Turbine Solar Taurus	Test 6 95% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.23	1.48	0.22	0.02	0.95
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Ethylene	ND	—	—	—	—
		Formaldehyde (HAP)	ND	—	—	—	—
		Methane	ND	—	—	—	—
		Methanol (HAP)	ND	—	—	—	—
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Turbine Solar Taurus	Test 7 95% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.04	1.23	0.19	0.02	0.83
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Ethylene	ND	—	—	—	—
		Formaldehyde (HAP)	ND	—	—	—	—
		Methane	ND	—	—	—	—
		Methanol (HAP)	ND	—	—	—	—
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Turbine Solar Taurus	Test 8 77% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.49	1.91	0.24	0.03	1.04
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Ethylene	ND	—	—	—	—
		Formaldehyde (HAP)	ND	—	—	—	—
		Methane	ND	—	—	—	—
		Methanol (HAP)	ND	—	—	—	—
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-13

Canister Analysis
Solar Taurus T6502

Engine		Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Turbine Solar Taurus	8	Test 8 77% Load	1,2,3-Trimethylbenzene	ND	ND	—	—	—
			1,2,4-Trimethylbenzene	ND	ND	—	—	—
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	ND	ND	—	—	—
			2,2,4-Trimethylpentane (HAP)	0.002	0.003	8.3E-04	9.5E-05	3.6E-03
			Acetylene	ND	ND	—	—	—
			Benzene (HAP)	0.006	0.008	1.7E-03	2.0E-04	7.4E-03
			Butane	0.22	0.28	4.5E-02	5.2E-03	2.0E-01
			Cyclohexane	0.01	0.01	3.4E-03	3.9E-04	1.5E-02
			Cyclopentane	0.004	0.005	9.7E-04	1.1E-04	4.2E-03
			Ethane	11.8	15.1	1.3E+00	1.5E-01	5.6E+00
			Ethyl Benzene (HAP)	ND	ND	—	—	—
			Ethylene	ND	ND	—	—	—
			n-Hexane (HAP)	0.04	0.05	1.3E-02	1.5E-03	5.7E-02
			Isobutane	0.20	0.25	4.2E-02	4.8E-03	1.8E-01
			Methanol (HAP)	ND	ND	—	—	—
			Methylcyclohexane	0.01	0.01	3.9E-03	4.5E-04	1.7E-02
			n-Nonane	ND	ND	—	—	—
			n-Octane	0.002	0.002	7.0E-04	8.1E-05	3.1E-03
			n-Pentane	0.08	0.10	2.0E-02	2.3E-03	8.7E-02
			Propane	1.59	2.04	2.5E-01	2.9E-02	1.1E+00
			Propylene	ND	ND	—	—	—
			Styrene (HAP)	ND	ND	—	—	—
			Toluene (HAP)	0.006	0.007	1.8E-03	2.1E-04	8.1E-03
			(m,p,o)-Xylene (HAP)	ND	ND	—	—	—

Table 4-14

GC Results
Solar Taurus T6502

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Turbine Solar Taurus	Test 6 95% Load	Methane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	—	—	—	—	—
Turbine Solar Taurus	Test 7 95% Load	Methane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	—	—	—	—	—
Turbine Solar Taurus	Test 8 77% Load	Methane	ND	—	—	—	—
		Ethane	ND	—	—	—	—
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	—	—	—	—	—

Table 4-15

CARB Method 430 Results
Solar Taurus T6502

Engine	Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Gas Turbine Solar Taurus	Test 6 95% Load	Formaldehyde (HAP)	0.03	0.04	3.6E-03	3.4E-04	1.6E-02
		Acetaldehyde (HAP)	0.05	0.06	8.5E-03	8.0E-04	3.7E-02
		Acrolein (HAP)	ND	—	—	—	—
		Butyrald/Isobutyraldehyde	0.01	0.02	4.0E-03	3.8E-04	1.8E-02
		Propanal	0.006	0.007	1.4E-03	1.3E-04	6.1E-03
Gas Turbine Solar Taurus	Test 8 77% Load	Formaldehyde (HAP)	0.53	0.68	5.8E-02	6.6E-03	2.5E-01
		Acetaldehyde (HAP)	0.37	0.47	5.8E-02	6.7E-03	2.6E-01
		Acrolein (HAP)	0.01	0.01	2.2E-03	2.6E-04	9.8E-03
		Butyrald/Isobutyraldehyde	0.08	0.10	2.0E-02	2.3E-03	8.6E-02
		Propanal	0.07	0.09	1.4E-02	1.6E-03	6.2E-02

Table 4-16

SW-846 Method 0010 Results
Solar Taurus

Engine	Condition	Pollutant	Conc. (µg/dscf)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Turbine Solar Taurus	Test 7 95% Load	Acenaphthene	ND	—	—	—
		Acenaphthylene	ND	—	—	—
		Anthrancene	ND	—	—	—
		Benzo(a)anthracene	ND	—	—	—
		Benzo(a)pyrene	ND	—	—	—
		Benzo(e)pyrene	ND	—	—	—
		Benzo(b)fluoranthene	ND	—	—	—
		Benzo(g,h,i)perylene	ND	—	—	—
		Benzo(k)fluoranthene	ND	—	—	—
		Biphenyl	0.30	1.1E-03	1.0E-04	4.7E-03
		Chrysene	0.003	9.8E-06	9.5E-07	4.3E-05
		Dibenz(a,h)anthracene	ND	—	—	—
		Fluoranthene	ND	—	—	—
		Fluorene	ND	—	—	—
		Indeno(1,2,3-c,d)pyrene	ND	—	—	—
		2-Methylnaphthalene	ND	—	—	—
		Naphthalene	0.01	4.7E-05	4.6E-06	2.1E-04
		Perylene	ND	—	—	—
		Phenanthrene	ND	—	—	—
		Phenol	0.04	1.5E-04	1.5E-05	6.6E-04
		Pyrene	ND	—	—	—

Table 4-17

Operating Conditions and CEM Results
Cooper-Bessemer GMVA-10 (Engine 9)

Test Period	12	13	14
Load Condition	Intermediate	Full	Full
Sampling Location	Exhaust	Exhaust	Exhaust
Date	11/11/94	11/12/94	11/12/94
Test Time	1600-1800	1000-1405	1515-1645
Ambient Conditions			
Barometric Pressure (in. Hg)	26.59	26.49	26.47
Ambient Temperature (°F)	65	57	59
Relative Humidity (%)	45.8	85.6	82.9
Abs. Humidity (lb H2O/1000 lb dry air)	6.6	9.3	10.0
Engine Operating Conditions			
Brake horsepower (BHP)	1078	1232	1234
Load (%)	88	100	100
Engine Speed (rpm)	299	300	300
Fuel Flow (scf/min)	168	174	173
Heat Input (MMBtu/hr) (a)	10.1	10.5	10.4
Heat Rate (Btu/BHP-hr, HHV)	9511	8631	8566
Heat Rate (Btu/BHP-hr, LHV)	8652	7851	7792
NG HHV (Btu/scf)	1020	1020	1020
NG LHV (Btu/scf)	928	928	928
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	4991	4715	4690
Vol. Flow (dscfm) - M19, Fd (b)	5079	4845	4756
Stack Gas Temperature (°F)	576	586	590
Moisture (%V)	7.2	8.3	8.4
O2 (%V dry)	15.1	14.6	14.5
CO2 (%V dry)	3.59	3.91	3.95
NOx (ppmvd)	299	396	391
CO (ppmvd)	69.2	67.6	67.1
THC (ppmvw)	2624	1342	1309
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	302	368	358
NOx (lb/hr)	10.9	13.7	13.3
NOx (g/BHP-hr)	4.58	5.06	4.89
NOx (lb/MMBtu)	1.08	1.31	1.28
NOx (tons/yr)	47.7	60.2	58.2
CO (ppmvd @ 15% O2)	69.9	62.8	61.6
CO (lb/hr)	1.53	1.43	1.39
CO (g/BHP-hr)	0.64	0.53	0.51
CO (lb/MMBtu)	0.15	0.14	0.13
CO (tons/yr)	6.71	6.25	6.09
THC (ppmvd @ 15% O2)	2856	1360	1311
THC (lb/hr)	35.8	17.7	16.9
THC (g/BHP-hr)	15.0	6.50	6.22
THC (lb/MMBtu)	3.54	1.69	1.62
THC (tons/yr)	157	77.3	74.1

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-18

FTIR Results
Cooper-Bessemer GMVA-10 (Engine 9)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 9 Cooper GMVA-10	Test 12 88% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	65.1	66.2	1.54	0.65	6.76
		Ethylene	5.87	5.97	0.13	0.05	0.57
		Formaldehyde (HAP)	18.8	19.1	0.44	0.19	1.95
		Methane	2582	2626	32.7	13.7	143
		Methanol (HAP)	0.67	0.68	0.02	0.007	0.07
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 9 Cooper GMVA-10	Test 13 100% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	39.1	36.7	0.89	0.33	3.88
		Ethylene	5.95	5.57	0.13	0.05	0.55
		Formaldehyde (HAP)	17.8	16.7	0.40	0.15	1.77
		Methane	1385	1297	16.7	6.15	73.2
		Methanol (HAP)	0.92	0.86	0.02	0.008	0.10
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 9 Cooper GMVA-10	Test 14 100% Load	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	39.7	36.6	0.88	0.32	3.86
		Ethylene	6.12	5.64	0.13	0.05	0.56
		Formaldehyde (HAP)	18.0	16.6	0.40	0.15	1.75
		Methane	1333	1229	15.8	5.80	69.2
		Methanol (HAP)	0.97	0.90	0.02	0.008	0.10
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-19

Canister Results
Cooper-Bessemer GMVA-10 (Engine 9)

Engine		Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 9 C-B GMVA-10 Exhaust	13	Test 13 100% Load	1,2,3-Trimethylbenzene	0.004	0.004	4.0E-04	1.5E-04	1.7E-03
			1,2,4-Trimethylbenzene	0.02	0.02	1.8E-03	6.5E-04	7.7E-03
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	ND	ND	—	—	—
			2,2,4-Trimethylpentane (HAP)	0.06	0.06	5.3E-03	2.0E-03	2.3E-02
			Acetylene	ND	ND	—	—	—
			Benzene (HAP)	0.08	0.07	4.4E-03	1.6E-03	1.9E-02
			Butane	1.02	0.96	4.5E-02	1.6E-02	2.0E-01
			Cyclohexane	0.04	0.04	2.7E-03	1.0E-03	1.2E-02
			Cyclopentane	0.02	0.01	7.9E-04	2.9E-04	3.5E-03
			Ethane	51.6	48.3	1.2E+00	4.3E-01	5.1E+00
			Ethyl Benzene (HAP)	0.004	0.004	3.4E-04	1.3E-04	1.5E-03
			Ethylene	ND	ND	—	—	—
			n-Hexane (HAP)	0.08	0.07	5.1E-03	1.9E-03	2.2E-02
			Isobutane	0.82	0.77	3.6E-02	1.3E-02	1.6E-01
			Methanol (HAP)	ND	ND	—	—	—
			Methylcyclohexane	0.04	0.03	2.7E-03	9.8E-04	1.2E-02
			n-Nonane	0.002	0.001	1.5E-04	5.3E-05	6.4E-04
			n-Octane	0.006	0.006	5.5E-04	2.0E-04	2.4E-03
			n-Pentane	0.23	0.22	1.3E-02	4.6E-03	5.5E-02
			Propane	8.34	7.81	2.8E-01	1.0E-01	1.2E+00
			Propylene	ND	ND	—	—	—
			Styrene (HAP)	0.003	0.002	2.0E-04	7.5E-05	8.9E-04
			Toluene (HAP)	0.06	0.05	3.8E-03	1.4E-03	1.7E-02
			(m,p,o)-Xylene (HAP)	0.01	0.01	1.1E-03	4.1E-04	4.9E-03

Table 4-20

GC Results
Cooper-Bessemer GMVA-10 (Engine 9)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 9 C-B GMVA-10	Test 12 88% Load	Methane	1855	2033	25.3	10.7	111
		Ethane	47.1	51.6	1.21	0.51	5.28
		Propane	6.44	7.06	0.24	0.10	1.06
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	113	124	1.55	0.65	6.79
Engine 9 C-B GMVA-10	Test 13 100% Load	Methane	1087	1110	14.3	5.28	62.8
		Ethane	26.6	27.2	0.66	0.24	2.88
		Propane	4.77	4.87	0.17	0.06	0.76
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	67.5	68.9	0.89	0.33	3.90
Engine 9 C-B GMVA-10	Test 14 100% Load	Methane	978	984	12.7	4.66	55.5
		Ethane	26.0	26.1	0.63	0.23	2.76
		Propane	6.81	6.85	0.24	0.09	1.06
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	72.3	72.8	0.94	0.34	4.11

Table 4-23

Operating Conditions and CEM Results
Cooper-Bessemer GMVC-10 (Engine 15)

Test Period	9	10	11
Load Condition	Full	Full	Intermediate
Sampling Location	Exhaust	Exhaust	Exhaust
Date	11/10/94	11/10/94	11/11/94
Test Time	1030-1500	1546-1801	0930-1140
Ambient Conditions			
Barometric Pressure (in. Hg)	26.72	26.64	26.66
Ambient Temperature (°F)	53	58	53
Relative Humidity (%)	46.5	36.2	62.6
Abs. Humidity (lb H2O/1000 lb dry air)	4.4	4.2	5.8
Engine Operating Conditions			
Brake horespower (BHP)	1827	1830	1523
Load (%)	102	102	85
Engine Speed (rpm)	300	300	299
Fuel Flow (scf/min)	266	266	265
Heat Input (MMBtu/hr) (a)	16.0	16.0	16.0
Heat Rate (Btu/BHP-hr, HHV)	8900	8884	10667
Heat Rate (Btu/BHP-hr, LHV)	8061	8046	9661
NG HHV (Btu/scf)	1020	1020	1020
NG LHV (Btu/scf)	924	924	924
Exhaust Gas Conditions			
Vol. Flow (dscfm) - M 2	7570	7588	7363
Vol. Flow (dscfm) - M19, Fd (b)	7972	7749	8769
Stack Gas Temperature (°F)	581	576	552
Moisture (%V)	7.00	7.00	6.90
O2 (%V dry)	15.0	14.8	15.5
CO2 (%V dry)	3.68	3.69	3.36
NOx (ppmvd)	560	638	278
CO (ppmvd)	71.2	71.1	76.2
THC (ppmvw)	971	957	1300
Exhaust Emissions			
NOx (ppmvd @ 15% O2)	560	620	306
NOx (lb/hr)	31.9	35.4	17.5
NOx (g/BHP-hr)	7.93	8.77	5.20
NOx (lb/MMBtu)	1.99	2.21	1.09
NOx (tons/yr)	140	155	76.5
CO (ppmvd @ 15% O2)	71.2	69.1	83.9
CO (lb/hr)	2.47	2.40	2.91
CO (g/BHP-hr)	0.61	0.59	0.87
CO (lb/MMBtu)	0.15	0.15	0.18
CO (tons/yr)	10.8	10.5	12.8
THC (ppmvd @ 15% O2)	1044	1000	1538
THC (lb/hr)	20.7	19.9	30.5
THC (g/BHP-hr)	5.15	4.92	9.08
THC (lb/MMBtu)	1.29	1.24	1.91
THC (tons/yr)	90.8	87.0	134

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-24

Operating Conditions and CEM Results
Cooper-Bessemer GMVC-10 (Engine 11)

Test Period Load Condition Sampling Location Date Test Time	19 Full Exhaust 11/15/94 1020-1120	22 Intermediate Exhaust 11/15/94 1225-1300	21 Intermediate Exhaust 11/15/94 1350-1415	20 Full Exhaust 11/15/94 1622-1655	24 Full Exhaust 11/15/94 1730-1813
Ambient Conditions					
Barometric Pressure (in. Hg)	27.02	26.97	26.93	26.91	26.89
Ambient Temperature (°F)	50	55	57	55	51
Relative Humidity (%)	33.5	28.7	26.0	29.3	36.2
Abs. Humidity (lb H2O/1000 lb dry air)	2.8	2.9	2.8	2.9	3.1
Engine Operating Conditions					
Brake horsepower (BHP)	1799	1569	1465	1724	1669
Load (%)	100	87	86	101	95
Engine Speed (rpm)	300	301	284	285	292
Fuel Flow (scf/min)	236	217	199	224	221
Heat Input (MMBtu/hr) (a)	14.2	13.1	12.0	13.5	13.3
Heat Rate (Btu/BHP-hr, HHV)	8038	8474	8323	7961	8113
Heat Rate (Btu/BHP-hr, LHV)	7281	7676	7539	7211	7349
NG HHV (Btu/scf)	1021	1021	1021	1021	1021
NG LHV (Btu/scf)	925	925	925	925	925
Exhaust Gas Conditions					
Vol. Flow (dscfm) - M 2	7501	7310	6833	7019	7172
Vol. Flow (dscfm) - M19, Fd (b)	6983	6880	6243	6312	6528
Stack Gas Temperature (°F)	592	569	561	583	576
Moisture (%V)	6.7	6.5	6.5	7.0	6.8
O2 (%V dry)	14.9	15.3	15.3	14.6	14.9
CO2 (%V dry)	3.8	3.6	3.5	3.9	3.7
NOx (ppmvd)	870	309	364	1426	757
CO (ppmvd)	63.6	77.9	74.0	57.0	65.3
THC (ppmvw)	958	1226	1092	895	973
Exhaust Emissions					
NOx (ppmvd @ 15% O2)	857	326	380	1338	745
NOx (lb/hr)	43.5	15.2	16.3	64.5	35.4
NOx (g/BHP-hr)	11.0	4.39	5.03	17.0	9.6
NOx (lb/MMBtu)	3.05	1.16	1.35	4.77	2.65
NOx (tons/yr)	191	66.6	71.2	282	155
CO (ppmvd @ 15% O2)	62.7	82.2	77.3	53.4	64.2
CO (lb/hr)	1.94	2.34	2.01	1.57	1.86
CO (g/BHP-hr)	0.49	0.68	0.62	0.41	0.50
CO (lb/MMBtu)	0.14	0.18	0.17	0.12	0.14
CO (tons/yr)	8.48	10.2	8.8	6.86	8.14
THC (ppmvd @ 15% O2)	1012	1384	1219	903	1027
THC (lb/hr)	17.9	22.5	18.2	15.1	17.0
THC (g/BHP-hr)	4.51	6.49	5.62	3.98	4.61
THC (lb/MMBtu)	1.25	1.72	1.51	1.12	1.27
THC (tons/yr)	78.3	98	79.5	66.3	74.3

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-25

FTIR Results
Cooper-Bessemer GMVC-10 (Engine 15)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	Emission Rates (g/BHP-hr)	Emission Rates (tons/yr)
Engine 15 Cooper GMVC-10	Test 9 102% Load (300 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.82	1.82	0.10	0.02	0.44
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	0.35	0.35	0.04	0.01	0.16
		Ethane	23.1	23.1	0.86	0.21	3.77
		Ethylene	7.40	7.40	0.26	0.06	1.13
		Formaldehyde (HAP)	18.1	18.1	0.67	0.17	2.95
		Methane	957	957	18.99	4.72	83.2
		Methanol (HAP)	0.70	0.70	0.03	0.01	0.12
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 15 Cooper GMVC-10	Test 10 102% Load (300 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.54	1.49	0.08	0.02	0.36
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	23.0	22.2	0.83	0.21	3.64
		Ethylene	7.41	7.17	0.25	0.06	1.10
		Formaldehyde (HAP)	18.3	17.7	0.66	0.16	2.90
		Methane	951	920	18.4	4.55	80.4
		Methanol (HAP)	0.69	0.67	0.03	0.007	0.12
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 15 Cooper GMVC-10	Test 11 85% Load (300 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	54.9	60.0	2.25	0.67	9.9
		Ethylene	8.01	8.75	0.31	0.09	1.34
		Formaldehyde (HAP)	22.4	24.5	0.92	0.27	4.02
		Methane	2190	2393	47.8	14.2	209
		Methanol (HAP)	0.74	0.80	0.03	0.01	0.14
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-25

(Continued)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 15 Cooper GMVC-10	After Engine Rebalance 100% Load (300 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	2.04	1.97	0.11	0.03	0.48
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	0.44	0.43	0.05	0.01	0.20
		Ethane	22.5	21.8	0.83	0.21	3.62
		Ethylene	7.42	7.18	0.25	0.06	1.11
		Formaldehyde (HAP)	18.3	17.7	0.67	0.17	2.94
		Methane	960	929	18.8	4.67	82.4
		Methanol (HAP)	0.71	0.69	0.03	0.007	0.12
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-26

FTIR Results
Cooper-Bessemer GMVC-10 (Engine 11)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 11 Cooper GMVC-10	Test 19 100% Load (300 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	24.2	23.8	0.79	0.20	3.46
		Ethylene	5.79	5.69	0.18	0.04	0.77
		Formaldehyde (HAP)	16.5	16.2	0.54	0.14	2.35
		Methane	967	950	16.8	4.24	73.6
		Methanol (HAP)	0.75	0.74	0.03	0.007	0.11
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 11 Cooper GMVC-10	Test 20 101% Load (285 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.92	1.80	0.08	0.02	0.36
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	22.8	21.3	0.67	0.18	2.94
		Ethylene	5.50	5.15	0.15	0.04	0.66
		Formaldehyde (HAP)	14.4	13.5	0.42	0.11	1.86
		Methane	883	827	13.9	3.65	60.8
		Methanol (HAP)	0.76	0.72	0.02	0.006	0.11
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 11 Cooper GMVC-10	Test 21 86% Load (284 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.71	1.80	0.07	0.02	0.32
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	27.0	28.5	0.79	0.24	3.45
		Ethylene	5.93	6.25	0.16	0.05	0.71
		Formaldehyde (HAP)	16.7	17.6	0.49	0.15	2.13
		Methane	1076	1133	16.7	5.18	73.2
		Methanol (HAP)	0.77	0.82	0.02	0.007	0.11
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-26

(Continued)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 11 Cooper GMVC-10	Test 22 87% Load (301 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	30.9	32.5	0.99	0.29	4.35
		Ethylene	6.60	6.95	0.20	0.06	0.87
		Formaldehyde (HAP)	18.9	20.0	0.61	0.18	2.66
		Methane	1220	1285	20.9	6.04	92
		Methanol (HAP)	0.85	0.89	0.03	0.01	0.13
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 11 Cooper GMVC-10	Test 24 95% Load (292 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	1.95	1.92	0.09	0.02	0.38
		Acetylene	ND	—	—	—	—
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	24.3	23.9	0.74	0.20	3.25
		Ethylene	5.79	5.69	0.16	0.04	0.72
		Formaldehyde (HAP)	15.4	15.2	0.47	0.13	2.06
		Methane	950	935	15.5	4.20	67.7
		Methanol (HAP)	0.75	0.74	0.02	0.007	0.11
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-27

GC Results
Cooper-Bessemer GMVC-10 (Engine 15)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 15 C-B GMVC-10	Test 9 102% Load (300 rpm)	Methane	718	772	15.4	3.82	67.3
		Ethane	18.5	19.9	0.74	0.18	3.26
		Propane	3.52	3.78	0.21	0.05	0.91
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	47.6	51.2	1.02	0.25	4.46
Engine 15 C-B GMVC-10	Test 10 102% Load (300 rpm)	Methane	647	673	13.5	3.34	58.9
		Ethane	17.3	18.0	0.68	0.17	2.96
		Propane	5.62	5.84	0.32	0.08	1.41
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	51.5	53.5	1.07	0.27	4.69
Engine 15 C-B GMVC-10	Test 11 85% Load (300 rpm)	Methane	1692	1986	39.8	11.9	174
		Ethane	38.9	45.6	1.71	0.51	7.50
		Propane	8.55	10.0	0.55	0.16	2.42
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	103	121	2.43	0.72	10.6

Table 4-28

GC Results
Cooper-Bessemer GMVC-10 (Engine 11)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 11 C-B GMVC-10	Test 19 100% Load (300 rpm)	Methane	847	892	15.8	3.99	69.3
		Ethane	21.5	22.6	0.75	0.19	3.30
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	43.0	45.3	0.80	0.20	3.52
Engine 11 C-B GMVC-10	Test 20 101% Load (285 rpm)	Methane	832	838	14.1	3.71	61.8
		Ethane	22.5	22.6	0.71	0.19	3.13
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	45.0	45.3	0.76	0.20	3.34
Engine 11 C-B GMVC-10	Test 21 86% Load (284 rpm)	Methane	861	970	14.4	4.45	62.9
		Ethane	24.2	27.3	0.76	0.23	3.31
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	48.4	54.6	0.81	0.25	3.54
Engine 11 C-B GMVC-10	Test 22 87% Load (301 rpm)	Methane	1144	1289	21.0	6.08	92
		Ethane	29.2	32.8	1.00	0.29	4.40
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	58.3	65.7	1.07	0.31	4.69
Engine 11 C-B GMVC-10	Test 24 99% Load (292 rpm)	Methane	795	838	13.9	3.78	60.9
		Ethane	22.1	23.3	0.72	0.20	3.17
		Propane	ND	—	—	—	—
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	44.2	46.6	0.77	0.21	3.38

Table 4-29

Canister Results
Cooper-Bessemer GMVC-10 (Engine 15)

Engine		Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
			1,2,3-Trimethylbenzene	0.004	0.004	6.2E-04	1.5E-04	2.7E-03
			1,2,4-Trimethylbenzene	0.02	0.02	2.6E-03	6.5E-04	1.1E-02
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	0.002	0.002	3.5E-04	8.6E-05	1.5E-03
			2,2,4-Trimethylpentane (HAP)	0.09	0.08	1.2E-02	2.9E-03	5.1E-02
			Acetylene	ND	ND	—	—	—
			Benzene (HAP)	0.15	0.15	1.4E-02	3.5E-03	6.2E-02
			Butane	1.79	1.73	1.3E-01	3.1E-02	5.5E-01
			Cyclohexane	0.08	0.07	7.6E-03	1.9E-03	3.3E-02
			Cyclopentane	0.023	0.022	1.9E-03	4.8E-04	8.5E-03
Engine 15		Test 10	Ethane	89.7	86.8	3.3E+00	8.1E-01	1.4E+01
C-B GMVC-10	10	102% Load	Ethyl Benzene (HAP)	0.007	0.007	8.7E-04	2.2E-04	3.8E-03
		(300 rpm)	Ethylene	ND	ND	—	—	—
			n-Hexane (HAP)	0.14	0.14	1.5E-02	3.6E-03	6.4E-02
			Isobutane	1.36	1.32	9.5E-02	2.4E-02	4.2E-01
			Methanol (HAP)	ND	ND	—	—	—
			Methylcyclohexane	0.06	0.05	6.5E-03	1.6E-03	2.9E-02
			n-Nonane	ND	ND	—	—	—
			n-Octane	0.004	0.004	5.2E-04	1.3E-04	2.3E-03
			n-Pentane	0.45	0.43	3.9E-02	9.7E-03	1.7E-01
			Propane	13.3	12.9	7.1E-01	1.8E-01	3.1E+00
			Propylene	ND	ND	—	—	—
			Styrene (HAP)	0.01	0.01	1.8E-03	4.5E-04	8.0E-03
			Toluene (HAP)	0.09	0.09	1.0E-02	2.6E-03	4.5E-02
			(m,p,o)-Xylene (HAP)	0.02	0.02	2.4E-03	6.0E-04	1.1E-02
			1,2,3-Trimethylbenzene	0.005	0.005	6.8E-04	1.7E-04	3.0E-03
			1,2,4-Trimethylbenzene	0.02	0.02	2.9E-03	7.2E-04	1.3E-02
			1,3-Butadiene (HAP)	ND	ND	—	—	—
			1,3,5-Trimethylbenzene	0.003	0.003	3.8E-04	9.3E-05	1.6E-03
			2,2,4-Trimethylpentane (HAP)	0.09	0.08	1.2E-02	3.0E-03	5.2E-02
			Acetylene	ND	ND	—	—	—
			Benzene (HAP)	0.15	0.15	1.4E-02	3.5E-03	6.2E-02
			Butane	1.83	1.77	1.3E-01	3.2E-02	5.6E-01
			Cyclohexane	0.08	0.07	7.6E-03	1.9E-03	3.3E-02
			Cyclopentane	0.02	0.02	2.0E-03	5.0E-04	8.9E-03
Engine 15		Test 10	Ethane	94.1	91.0	3.4E+00	8.5E-01	1.5E+01
C-B GMVC-10	10	102% Load	Ethyl Benzene (HAP)	0.007	0.007	8.7E-04	2.2E-04	3.8E-03
		(300 rpm)	Ethylene	ND	ND	—	—	—
		Duplicate	n-Hexane (HAP)	0.14	0.14	1.5E-02	3.6E-03	6.4E-02
			Isobutane	1.39	1.34	9.7E-02	2.4E-02	4.3E-01
			Methanol (HAP)	ND	ND	—	—	—
			Methylcyclohexane	0.06	0.05	6.5E-03	1.6E-03	2.9E-02
			n-Nonane	0.001	0.001	1.5E-04	3.8E-05	6.8E-04
			n-Octane	0.004	0.004	5.2E-04	1.3E-04	2.3E-03
			n-Pentane	0.44	0.43	3.8E-02	9.5E-03	1.7E-01
			Propane	14.2	13.8	7.6E-01	1.9E-01	3.3E+00
			Propylene	ND	ND	—	—	—
			Styrene (HAP)	0.02	0.01	1.9E-03	4.7E-04	8.3E-03
			Toluene (HAP)	0.09	0.09	9.9E-03	2.5E-03	4.3E-02
			(m,p,o)-Xylene (HAP)	0.02	0.02	2.3E-03	5.7E-04	1.0E-02

Table 4-30

CARB Method 430 Results
Cooper-Bessemer GMVC-10 (Engine 15)

Engine	Condition	Pollutant	Conc. (ppmvd)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 15 C-B GMVC-10	Test 10 102% Load (300 rpm)	Formaldehyde (HAP)	18.2	17.6	6.6E-01	1.6E-01	2.9E+00
		Acetaldehyde (HAP)	1.32	1.27	7.0E-02	1.7E-02	3.1E-01
		Acrolein (HAP)	0.24	0.23	1.6E-02	4.0E-03	7.0E-02
		Butyrald/Isobutyraldehyde	0.04	0.04	3.7E-03	9.3E-04	1.6E-02
		Propanal	0.06	0.05	3.8E-03	9.5E-04	1.7E-02
Engine 15 C-B GMVC-10	Test 11 85% Load (300 rpm)	Formaldehyde (HAP)	24.2	26.4	9.9E-01	3.0E-01	4.3E+00
		Acetaldehyde (HAP)	2.28	2.50	1.4E-01	4.1E-02	6.0E-01
		Acrolein (HAP)	0.32	0.35	2.5E-02	7.3E-03	1.1E-01
		Butyrald/Isobutyraldehyde	0.09	0.10	9.1E-03	2.7E-03	4.0E-02
		Propanal	0.38	0.41	3.0E-02	8.9E-03	1.3E-01

Table 4-31

SW-846 Method 0010 Results
Cooper-Bessemer GMVC-10 (Engine 15)

Engine	Condition	Pollutant	Conc. (µg/dscf)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 15 C-B GMVC-10	Test 9 102% Load (300 rpm)	Acenaphthene	0.02	2.3E-05	5.7E-06	1.0E-04
		Acenaphthylene	0.05	4.9E-05	1.2E-05	2.2E-04
		Anthracene	0.009	9.2E-06	2.3E-06	4.0E-05
		Benzo(a)anthracene	0.005	5.5E-06	1.4E-06	2.4E-05
		Benzo(a)pyrene	ND	—	—	—
		Benzo(e)pyrene	ND	—	—	—
		Benzo(b)fluoranthene	ND	—	—	—
		Benzo(g,h,i)perylene	ND	—	—	—
		Benzo(k)fluoranthene	ND	—	—	—
		Biphenyl	0.06	6.0E-05	1.5E-05	2.6E-04
		Chrysene	0.01	1.2E-05	2.9E-06	5.2E-05
		Dibenz(a,h)anthracene	ND	—	—	—
		Fluoranthene	0.007	7.0E-06	1.7E-06	3.1E-05
		Fluorene	ND	—	—	—
		Indeno(1,2,3-c,d)pyrene	ND	—	—	—
		2-Methylnaphthalene	0.35	3.6E-04	9.0E-05	1.6E-03
		Naphthalene	0.71	7.5E-04	1.9E-04	3.3E-03
		Perylene	ND	—	—	—
		Phenanthrene	0.05	5.6E-05	1.4E-05	2.5E-04
		Phenol	0.54	5.7E-04	1.4E-04	2.5E-03
		Pyrene	0.009	9.3E-06	2.3E-06	4.1E-05

Table 4-32

Operating Conditions and CEM Results
Cooper-Bessemer GMWC-10 (Engine 13)

Test Period	15	16	17	18	23
Load Condition	Full	Full	Intermediate	Full	Full
Sampling Location	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Date	11/14/94	11/14/94	11/14/94	11/14/94	11/14/94
Test Time	1030-1130	1510-1549	1700-1745	1855-1925	2025-2100
Ambient Conditions					
Barometric Pressure (in. Hg)	26.75	26.76	26.79	26.83	26.87
Ambient Temperature (°F)	62	66	64	55	51
Relative Humidity (%)	24.0	20.9	24.3	42.7	52.5
Abs. Humidity (lb H2O/1000 lb dry air)	3.2	3.2	3.4	4.3	4.5
Engine Operating Conditions					
Brake horsepower (BHP)	3352	3054	2822	3172	3092
Load (%)	96	95	88	91	92
Engine Speed (rpm)	250	230	230	249	240
Fuel Flow (scf/min)	459	421	389	440	426
Heat Input (MMBtu/hr) (a)	27.8	25.5	23.6	26.6	25.8
Heat Rate (Btu/BHP-hr, HHV)	8423	8478	8481	8527	8474
Heat Rate (Btu/BHP-hr, LHV)	7625	7675	7677	7720	7671
NG HHV (Btu/scf)	1025	1025	1025	1025	1025
NG LHV (Btu/scf)	928	928	928	928	928
Exhaust Gas Conditions					
Vol. Flow (dscfm) - M 2	14164	12594	12422	13942	13360
Vol. Flow (dscfm) - M19, Fd (b)	13104	11888	11794	13514	12978
Stack Gas Temperature (°F)	653	651	615	621	617
Moisture (%V)	6.91	7.06	6.67	6.77	6.85
O2 (%V)	14.7	14.6	15.0	15.1	15.1
CO2 (%V)	3.84	3.96	3.66	3.68	3.72
NOx (ppmvd)	1695	2105	1425	1204	1449
CO (ppmvd)	114	119	94.9	105	103
THC (ppmvw)	1710	1743	1759	1785	1754
Exhaust Emissions					
NOx (ppmvd @ 15% O2)	1605	1971	1432	1226	1464
NOx (lb/hr)	159	179	120	116	135
NOx (g/BHP-hr)	21.5	26.6	19.3	16.7	19.8
NOx (lb/MMBtu)	5.72	7.02	5.10	4.37	5.22
NOx (tons/yr)	697	785	527	510	590
CO (ppmvd @ 15% O2)	108	111	95.4	107	104
CO (lb/hr)	6.53	6.14	4.88	6.16	5.82
CO (g/BHP-hr)	0.88	0.91	0.78	0.88	0.85
CO (lb/MMBtu)	0.23	0.24	0.21	0.23	0.23
CO (tons/yr)	28.6	26.9	21.4	27.0	25.5
THC (ppmvd @ 15% O2)	1739	1756	1895	1951	1902
THC (lb/hr)	60.0	55.5	55.4	64.4	60.9
THC (g/BHP-hr)	8.11	8.25	8.90	9.21	8.93
THC (lb/MMBtu)	2.16	2.18	2.35	2.42	2.36
THC (tons/yr)	263	243	243	282	267

a Based on HHV
b Used in emission calculations.
Note: Heating values based on 60°F reference.
M19 flow rates based on 68°F reference.

Table 4-33

FTIR Results
Cooper-Bessemer GMWC-10 (Engine 13)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 13 Cooper GMWC-10	Test 15 96% Load (250 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	1.78	1.70	0.09	0.01	0.41
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	46.4	44.2	2.84	0.38	12.4
		Ethylene	10.7	10.2	0.61	0.08	2.67
		Formaldehyde (HAP)	29.8	28.4	1.83	0.25	7.99
		Methane	1724	1640	56.2	7.61	246
		Methanol (HAP)	1.59	1.51	0.10	0.01	0.46
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 13 Cooper GMWC-10	Test 16 95% Load (230 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	2.01	1.88	0.10	0.01	0.42
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	45.6	42.7	2.53	0.38	11.1
		Ethylene	11.0	10.3	0.57	0.08	2.49
		Formaldehyde (HAP)	30.7	28.7	1.70	0.25	7.46
		Methane	1726	1617	51.1	7.59	224
		Methanol (HAP)	1.68	1.57	0.10	0.01	0.43
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 13 Cooper GMWC-10	Test 17 88% Load (230 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	1.56	1.56	0.07	0.01	0.33
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	48.1	48.1	2.65	0.43	11.6
		Ethylene	9.81	9.81	0.50	0.08	2.21
		Formaldehyde (HAP)	26.5	26.5	1.46	0.23	6.40
		Methane	1759	1759	51.7	8.3	226
		Methanol (HAP)	1.39	1.39	0.08	0.01	0.36
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-33

(Continued)

Engine	Condition	Pollutant	Conc (ppmvd)	Conc. (ppmvd @15% O2)	Emission Rates (lb/hr)	(g/BHP-hr)	(tons/yr)
Engine 13 Cooper GMWC-10	Test 18 91% Load (249 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	1.56	1.59	0.09	0.01	0.37
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	50.2	51.1	3.17	0.45	13.9
		Ethylene	10.4	10.6	0.62	0.09	2.69
		Formaldehyde (HAP)	28.2	28.7	1.78	0.25	7.79
		Methane	1813	1844	61.0	8.72	267
		Methanol (HAP)	1.47	1.49	0.10	0.01	0.43
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—
Engine 13 Cooper GMWC-10	Test 23 92% Load (240 rpm)	1,3-Butadiene (HAP)	ND	—	—	—	—
		Acetaldehyde (HAP)	ND	—	—	—	—
		Acetylene	1.62	1.64	0.08	0.01	0.37
		Acrolein (HAP)	ND	—	—	—	—
		Benzene (HAP)	ND	—	—	—	—
		Cyclohexane	ND	—	—	—	—
		Ethane	48.7	49.5	2.95	0.43	12.9
		Ethylene	10.2	10.4	0.58	0.08	2.54
		Formaldehyde (HAP)	27.9	28.4	1.69	0.25	7.40
		Methane	1772	1803	57.3	8.40	251
		Methanol (HAP)	1.42	1.44	0.09	0.01	0.40
		m-Xylene (HAP)	ND	—	—	—	—
		Propylene	ND	—	—	—	—
		Toluene (HAP)	ND	—	—	—	—

Table 4-34

GC Results
Cooper-Bessemer GMWC-10 (Engine 13)

Engine	Condition	Pollutant	Conc. (ppmvw)	Conc. (ppmvd @ 15% O2)	Emission Rate (lb/hr)	Emission Rate (g/BHP-hr)	Emission Rate (tons/yr)
Engine 13 C-B GMWC-10	Test 15 96% Load (250 rpm)	Methane	1487	1520	52.2	7.08	229
		Ethane	33.4	34.1	2.20	0.30	9.62
		Propane	4.77	4.88	0.46	0.06	2.02
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	81.0	82.8	2.85	0.39	12.5
Engine 13 C-B GMWC-10	Test 16 95% Load (230 rpm)	Methane	1539	1551	49.2	7.31	215
		Ethane	34.8	35.1	2.08	0.31	9.12
		Propane	5.16	5.20	0.45	0.07	1.98
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	85.1	85.7	2.72	0.40	11.9
Engine 13 C-B GMWC-10	Test 17 88% Load (230 rpm)	Methane	1598	1712	50.4	8.11	221
		Ethane	38.6	41.3	2.28	0.37	10.0
		Propane	7.89	8.45	0.68	0.11	3.00
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	101	108	3.18	0.51	13.9
Engine 13 C-B GMWC-10	Test 18 91% Load (249 rpm)	Methane	1540	1680	55.7	7.97	244
		Ethane	37.3	40.7	2.53	0.36	11.1
		Propane	7.84	8.55	0.78	0.11	3.42
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	98.2	107	3.55	0.51	15.6
Engine 13 C-B GMWC-10	Test 23 92% Load (240 rpm)	Methane	1523	1664	53.0	7.78	232
		Ethane	36.1	39.4	2.35	0.35	10.3
		Propane	7.00	7.64	0.67	0.10	2.93
		Butane	ND	—	—	—	—
		Pentane	ND	—	—	—	—
		C2 - C5 as Methane	93.2	102	3.24	0.48	14.2

Table 4-35

Crankcase Vent
Canister Results

Sampling Location	Condition	Pollutant	Conc. (ppmvd)	Emission Rate (lb/hr)	Emission Rate (tons/yr)
Station 6C Engine 15 C-B GMVC-10 Crankcase Vent	Test 10 101% Load	1,2,3-Trimethylbenzene	0.01	1.4E-05	6.1E-05
		1,2,4-Trimethylbenzene	0.02	2.4E-05	1.0E-04
		1,3-Butadiene (HAP)	ND	—	—
		1,3,5-Trimethylbenzene	0.002	2.0E-06	8.5E-06
		2,2,4-Trimethylpentane (HAP)	0.02	2.6E-05	1.2E-04
		Benzene (HAP)	0.05	3.7E-05	1.6E-04
		Butane	0.90	5.5E-04	2.4E-03
		Cyclohexane	0.07	5.7E-05	2.5E-04
		Cyclopentane	0.02	1.4E-05	6.1E-05
		Ethane	37.0	1.2E-02	5.1E-02
		Ethyl Benzene (HAP)	0.02	2.2E-05	9.8E-05
		n-Hexane (HAP)	0.13	1.2E-04	5.1E-04
		Isobutane	0.64	3.9E-04	1.7E-03
		Methanol (HAP)	ND	—	—
		Methylcyclohexane	0.79	8.2E-04	3.6E-03
		n-Nonane	0.02	2.7E-05	1.2E-04
		n-Octane	0.03	3.0E-05	1.3E-04
		Propane	5.58	2.6E-03	1.1E-02
		Styrene (HAP)	0.004	3.9E-06	1.7E-05
		Toluene (HAP)	0.22	2.1E-04	9.3E-04
		(m,p,o)-Xylene (HAP)	0.06	6.8E-05	3.0E-04
Station 6A Engine 12 Clark HBA-5 Crankcase Vent	Test 4 73% Load	1,2,3-Trimethylbenzene	0.02	—	—
		1,2,4-Trimethylbenzene	0.03	—	—
		1,3-Butadiene (HAP)	0.13	—	—
		1,3,5-Trimethylbenzene	0.03	—	—
		2,2,4-Trimethylpentane (HAP)	0.29	—	—
		Benzene (HAP)	0.45	—	—
		Butane	22.3	—	—
		Cyclohexane	1.07	—	—
		Cyclopentane	0.53	—	—
		Ethane	2060	—	—
		Ethyl Benzene (HAP)	0.07	—	—
		n-Hexane (HAP)	2.06	—	—
		Isobutane	17.8	—	—
		Methanol (HAP)	ND	—	—
		Methylcyclohexane	1.30	—	—
		n-Nonane	0.007	—	—
		n-Octane	0.20	—	—
		Propane	217	—	—
		Styrene (HAP)	0.01	—	—
		Toluene (HAP)	1.85	—	—
		(m,p,o)-Xylene (HAP)	0.23	—	—

Note: Unable to measure flow rate due to crankcase vent design on Engine 12.

Table 4-36

Fuel Gas
Canister Results

Sampling Location	Condition	Pollutant	Conc. (ppmvd)
Station 6A Engine 10 Clark BA-5 Fuel Gas	Test 3 80% Load	1,2,3-Trimethylbenzene	ND
		1,2,4-Trimethylbenzene	ND
		1,3-Butadiene (HAP)	ND
		1,3,5-Trimethylbenzene	ND
		2,2,4-Trimethylpentane (HAP)	5.69
		Benzene (HAP)	7.56
		Butane	763
		Cyclohexane	25.3
		Cyclopentane	8.14
		Ethane	33431
		Ethyl Benzene (HAP)	ND
		n-Hexane (HAP)	47.8
		Isobutane	564
		Methanol (HAP)	ND
		Methylcyclohexane	27.5
		n-Nonane	0.65
		n-Octane	3.58
		Propane	4923
		Styrene (HAP)	ND
		Toluene (HAP)	9.40
		(m,p,o)-Xylene (HAP)	1.41
Station 6C Engine 15 C-B GMVC-10 Fuel Gas	Test 10 101% Load	1,2,3-Trimethylbenzene	ND
		1,2,4-Trimethylbenzene	ND
		1,3-Butadiene (HAP)	ND
		1,3,5-Trimethylbenzene	ND
		2,2,4-Trimethylpentane (HAP)	5.02
		Benzene (HAP)	7.66
		Butane	641
		Cyclohexane	25.8
		Cyclopentane	7.81
		Ethane	30300
		Ethyl Benzene (HAP)	ND
		n-Hexane (HAP)	47.9
		Isobutane	478
		Methanol (HAP)	ND
		Methylcyclohexane	25.2
		n-Nonane	0.75
		n-Octane	ND
		Propane	4190
		Styrene (HAP)	ND
		Toluene (HAP)	8.00
		(m,p,o)-Xylene (HAP)	1.40

Table 4-37

Ambient Air Analysis

Sampling Location	Condition	Pollutant	Conc. (ppmvd)
Station 6A Engine 10 Clark BA-5 Inlet Ambient Air	Test 2 100% Load	1,2,3-Trimethylbenzene	ND
		1,2,4-Trimethylbenzene	ND
		1,3-Butadiene (HAP)	ND
		1,3,5-Trimethylbenzene	ND
		2,2,4-Trimethylpentane (HAP)	ND
		Benzene (HAP)	0.002
		Butane	0.05
		Cyclohexane	0.002
		Cyclopentane	ND
		Ethane	1.56
		Ethyl Benzene (HAP)	ND
		n-Hexane (HAP)	0.006
		Isobutane	0.04
		Methanol (HAP)	ND
		Methylcyclohexane	0.002
		n-Nonane	ND
		n-Octane	ND
		Propane	0.29
		Styrene (HAP)	ND
		Toluene (HAP)	0.002
		(m,p,o)-Xylene (HAP)	ND
Station 6C Engine 15 C-B GMVC-10 Inlet Ambient Air	Test 10 101% Load	1,2,3-Trimethylbenzene	ND
		1,2,4-Trimethylbenzene	ND
		1,3-Butadiene (HAP)	ND
		1,3,5-Trimethylbenzene	ND
		2,2,4-Trimethylpentane (HAP)	ND
		Benzene (HAP)	ND
		Butane	0.006
		Cyclohexane	ND
		Cyclopentane	ND
		Ethane	0.04
		Ethyl Benzene (HAP)	ND
		n-Hexane (HAP)	0.002
		Isobutane	0.002
		Methanol (HAP)	ND
		Methylcyclohexane	ND
		n-Nonane	ND
		n-Octane	ND
		Propane	0.01
		Styrene (HAP)	ND
		Toluene (HAP)	ND
		(m,p,o)-Xylene (HAP)	ND