California Environmental Protection Agency
AIR RESOURCES BOARD

DETERMINATION OF REASONABLY AVAILABLE CONTROL TECHNOLOGY AND BEST AVAILABLE RETROFIT CONTROL TECHNOLOGY FOR STATIONARY SPARK-IGNITED INTERNAL COMBUSTION ENGINES

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GLOSSARY OF TERMS, ABBREVIATIONS, AND SYMBOLS

AFRC	Air/fuel ratio controller
ARB	Air Resources Board
APCD	Air Pollution Control District
AQMD	Air Quality Management District
BAAQMD	Bay Area Air Quality Management District
BARCT	Best available retrofit control technology
bhp	Brake horsepower
Btu	British thermal unit
BSFC	Brake specific fuel consumption (Btu/bhp-hour)
CAA	Federal Clean Air Act Amendments
CAPCOA	California Air Pollution Control Officers Association
CCAA	California Clean Air Act
CEMS	Continuous Emissions Monitoring System
CI	Compression ignited
CO	Carbon monoxide
EGR	Exhaust gas recirculation
gal	Gallon
gm/bhp-hr	Gram per brake horsepower-hour
HAPs	Hazardous air pollutants
HC	Hydrocarbons
HNCO	Gaseous isocyanic acid
$HNCO_3$	Cyanuric acid
ICCR	Industrial Combustion Coordinated Rulemaking
IC Engines	Internal combustion engines
I & M	Inspection and monitoring
lbm/day	Pounds mass per day
LPG	Liquified petroleum gas
MACT	Maximum achievable control technology
NO	Nitric oxide
N_2	Molecular nitrogen
N_2O	Nitrous oxide
NMHC	Non-methane hydrocarbon compounds
NOx	Nitrogen oxides
NO_2	Nitrogen dioxide
NSCR	Nonselective catalytic reduction
O_2	Oxygen
PAH	Polycyclic aromatic hydrocarbons
PM	Particulate matter
PM2.5	Particulate matter less than 2.5 micrometers
PM10	Particulate matter less than 10 micrometers

ppm	Parts per million
ppmv	Parts per million by volume
PSC	Prestratified charge
RACT	Reasonably available control technology
RECLAIM	Regional Clean Air Incentives Market
ROC	Reactive organic compounds
RRP	Risk Reduction Plan
SCR	Selective catalytic reduction
SI	Spark ignited
SOx	Sulfur oxides
TAC	Toxic air contaminant
VCAPCD	Ventura County Air Pollution Control District
VOC	Volatile organic compounds

RACT/BARCT DETERMINATION
FOR STATIONARY SPARK-IGNITED INTERNAL COMBUSTION ENGINES

I. INTRODUCTION

This document presents the determination of reasonably available control technology (RACT) and best available retrofit control technology (BARCT) for controlling nitrogen oxides (NOx), volatile organic compounds (VOCs), and carbon monoxide (CO) from stationary, spark-ignited (SI) reciprocating internal combustion (IC) engines. This report also presents the basis for the determination, an overview of the control technologies for spark-ignited engines, an assessment of the cost and cost-effectiveness, and the expected associated economic and other impacts. The determination was developed by the Air Resources Board (ARB) staff and a workgroup made up of representatives of the air pollution control and air quality management districts (districts).

It is important to note that this determination is a non-regulatory guidance document with the purpose of assisting districts in developing regulations for stationary IC engines. Nothing in our guidance precludes districts from adopting different or more stringent rules or from varying from the determination to consider site specific situations.

A. Background

The California Health and Safety Code section 40000 states that the districts have the primary responsibility for control of air pollution from all sources, other than emissions from motor vehicles. The California Clean Air Act (CCAA) of 1988 requires that the districts develop attainment plans to achieve the state ambient air quality standards by the earliest practicable date. These plans must include measures that require control technologies for reducing emissions from existing sources. RACT/BARCT determinations aid districts in developing regulations to attain and maintain the state ambient air quality standards. The determinations also promote consistency of controls for similar emission sources among districts with the same air quality attainment designations.

While the CCAA does not define RACT, RACT for existing sources is generally considered to be those emission limits that would result from the application of demonstrated technology to reduce emissions. BARCT is defined in the California Health and Safety Code, section 40406, but applicable statewide in this case, as “an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source.”

The California Health and Safety Code, section 40918(a)(2), requires nonattainment areas that are classified as moderate for the State ozone standard to include in their attainment plan the use of RACT for all existing stationary sources, and BARCT for existing stationary sources permitted to emit 5 tons or more per day or 250 tons or more per year of nonattainment pollutants or their precursors. This requirement applies to the extent necessary to achieve standards by the earliest practicable date.

The California Health and Safety Code, section 40919(a)(3), requires nonattainment areas that are classified as serious for the State ozone standard to include in their attainment plan the use of BARCT on all permitted stationary sources to the extent necessary to achieve standards by the earliest practicable date. Districts classified as being severe nonattainment must take all measures required of moderate and serious nonattainment areas. In addition, Title 17, Section 70600 of the California Code of Regulations requires districts to adopt BARCT if the districts are within an area of origin of transported air pollutants, as defined in Section 70500(c).

In developing this determination, the ARB and air districts staff reviewed a number of reports on spark-ignited IC engines, emissions inventory data, vendor literature, source test data, district rules and accompanying staff reports, and other sources of information regarding SI engines.

Stationary spark-ignited IC engines are major contributors of NOx, VOC, and CO emissions to the atmosphere. The 1996 point source emissions inventory for stationary SI engines includes about 21,932 tons of NOx per year, 16,479 tons of CO per year, and 23,606 tons of VOC per year from IC engines. Tables I-1, I-2, and I-3 summarize this inventory by district. As can be seen from these tables, spark-ignited IC engines are responsible for a significant percentage of the NOx, VOC, and CO emissions from stationary point sources in California. This significance, however, varies from district to district. The 1996 point source emissions inventory also indicates that there are approximately 5,900 diesel-fueled and spark-ignited engines located at 1,700 facilities statewide. Forty-four percent of these engines are fueled by diesel fuel; 42 percent are fueled by natural gas; 7 percent are fueled by gasoline; and 4 percent are fueled by propane with the remainder fueled by waste gas and other fuels.

It should be noted that not all districts in California with significant stationary source IC engine emissions are included in Tables I-1, I-2, and I-3. In some districts, all stationary IC engines emissions may not have been reported in the 1996 emissions inventory. In those cases, these tables underestimate the actual emissions.

In other cases, some classes of spark-ignited IC engines with substantial emissions may be exempt from permit, and their emissions may not be reflected in Tables I-1, I-2, and I-3. For example, engines used in agricultural operations in the San Joaquin Valley Unified Air Pollution Control District (APCD) are exempt from permit and their emissions are not included in these tables. Annual NOx emissions for these agricultural engines (spark-ignited and diesel-fueled) have been estimated at 12,000 tons per year. This emissions estimate is greater than the NOx emissions for all stationary engines in the inventory for San Joaquin Valley APCD. Moreover, this annual NOx estimate is approximately 40 percent of the emissions from the stationary IC engines in the State as reported in the 1996 point source inventory. It appears that agricultural engines can be a significant contributor to emissions. Because of the potential adverse air quality impacts from these engines, the control of emissions from IC engines used in agricultural operations will be addressed. It should also be noted that it is believed that the majority of these engines are diesel-fueled.

Table I-1

NO_x Emissions Comparison
Stationary Spark-Ignited IC Engines and All Stationary Sources
in Tons Per Year

District*	Spark-Ignited IC Engines	All Stationary Sources	Percent of Total
Antelope Valley APCD	0.1	365	0.03
Bay Area AQMD	2,077	36,500	5.7
Butte County AQMD	14	730	1.9
Colusa County APCD	680	1,460	47
Feather River AQMD	361	1,100	33
Glenn County APCD	325	1,100	30
Lake County AQMD	0.06	146	0.04
Mojave Desert AQMD	7,499	31,000	24
Monterey Bay Unified APCD	76	7,300	1.0
Northern Sierra AQMD	0.3	730	0.04
Sacramento Metropolitan AQMD	27	1,825	1.5
San Diego County APCD	238	5,840	4.2
San Joaquin Valley Unified APCD	4,882	65,700	7.4
San Luis Obispo County APCD	92	1,460	6.3
Santa Barbara County APCD	985	2,190	45
South Coast AQMD	4,259	47,450	9.0
Ventura County APCD	176	1,825	9.6
Yolo/Solano AQMD	241	1,100	22
Totals	**21,932**	**218,776**	**10**

Source: ARB 1996 Point Source Inventory

* APCD = Air Pollution Control District
AQMD = Air Quality Management District

Table I-2

CO Emissions Comparison
Stationary Spark-Ignited IC Engines and All Stationary Sources
in Tons Per Year

District*	Spark-Ignited IC Engines	All Stationary Sources	Percent of Total
Amador APCD	NR	1,100	-
Antelope Valley APCD	1.3	365	0.4
Bay Area AQMD	1,932	21,170	9.1
Butte County AQMD	1.0	1,460	0.07
Colusa County APCD	88	365	24
Feather River AQMD	128	730	17
Glenn County APCD	75	1,100	6.8
Great Basin Unified APCD	NR	7.3	-
Imperial County APCD	NR	365	-
Kern County APCD	NR	730	-
Lake County AQMD	0.01	3,285	0
Mojave Desert AQMD	1,094	5,840	19
Monterey Bay Unified APCD	79	10,585	0.7
Northern Sierra AQMD	0.06	4,015	0
Placer County APCD	NR	730	-
Sacramento Metro AQMD	56	730	7.7
San Diego County APCD	526	7,665	7.0
San Joaquin Valley Unified APCD	4,818	22,630	21
San Luis Obispo County APCD	57	365	16
Santa Barbara County APCD	928	1,460	64
South Coast AQMD	5,095	22,630	23
Ventura County APCD	1,553	3,285	47
Yolo-Solano AQMD	48	730	6.6
Totals	**16,479**	**111,342**	**15**

Source: ARB 1996 Point Source Inventory

* APCD = Air Pollution Control District
AQMD = Air Quality Management District

Table I-3

VOC Emissions Comparison
Stationary Spark-Ignited IC Engines and All Stationary Sources
in Tons Per Year

District*	Spark-Ignited IC Engines	All Stationary Sources	Percent of Total
Amador County APCD	NR	365	-
Antelope Valley APCD	1.6	1,100	0.15
Bay Area AQMD	822	43,800	1.9
Butte County AQMD	3	1,100	0.3
Colusa County APCD	275	730	38
Feather River AQMD	148	1,460	10
Glenn County APCD	146	730	20
Imperial County APCD	NR	730	-
Kern County APCD	NR	365	-
Lake County AQMD	0.003	730	0
Mojave Desert AQMD	1,209	2,920	41
Monterey Bay Unified APCD	362	5,475	6.6
Northern Sierra AQMD	0.02	730	0
Placer County APCD	NR	2,555	-
Sacramento Metro AQMD	23	6,570	0.4
San Diego County APCD	666	16,425	4.1
San Joaquin Valley Unified APCD	6,,776	43,800	15
San Luis Obispo County APCD	9.6	2,555	0.4
Santa Barbara County APCD	1,684	2,920	58
South Coast AQMD	11,116	109,500	10
Ventura County APCD	352	3,650	9.6
Yolo-Solano AQMD	13	4,015	0.3
Totals	**23,606**	**252,225**	**9.4**

Source: ARB 1996 Point Source Inventory

* APCD = Air Pollution Control District
AQMD = Air Quality Management District

IC engines generate power by combustion of an air/fuel mixture. In the case of spark-ignited engines, a spark plug ignites the air/fuel mixture while a diesel-fueled IC engine relies on heating of the inducted air during the compression stroke to ignite the injected diesel fuel. A more detailed description of spark-ignited IC engine operation is included in Appendix B. Most stationary IC engines are used to power pumps, compressors, or electrical generators. IC engines are used in the following industries: oil and gas pipelines, oil and gas production, water transport, general industrial (including construction), electrical power generation, and agriculture. The combined NOx emissions from the oil and gas industry, manufacturing facilities, power plants, and landfill and waste water treatment facilities contribute almost 85 percent of the annual NOx emissions from stationary IC engines according to the 1996 point source inventory. According to the inventory, approximately 11 percent of the annual NOx emissions from the engines in these categories are emitted by diesel-fueled stationary IC engines with the remaining 89 percent emitted from stationary spark-ignited IC engines.

Engines used for electrical power generation include base load power generation (generally in remote areas), resource recovery facilities in areas where waste fuels are available (such as landfills and sewage treatment facilities), portable units used as temporary sources of electrical power, and emergency generators used during electrical power outages.

There are a wide variety of spark-ignited IC engine designs, such as:

? Two stroke and four stroke
? Rich-burn and lean-burn
? Supercharged, turbocharged, and naturally aspirated

Spark-ignited engines can use one or more fuels, such as natural gas, oil field gas, digester gas, landfill gas, propane, butane, liquefied petroleum gas (LPG), gasoline, methanol, ethanol, residual oil, and crude oil. IC engines can also exhibit a wide variety of operating modes, such as:

? Emergency operation (e.g., used only during testing, maintenance, and emergencies)
? Seasonal operation
? Continuous operation
? Continuous power output
? Cyclical power output

These differences in use, design, and operating modes must be taken into account when setting standards to control emissions from IC engines.

B. Diesel-fueled Engines

Diesel engines not only have significant NOx emissions but also emit particulate matter (PM) which has been identified as a Toxic Air Contaminant (TAC) by the ARB. Once a substance is identified as a TAC, the ARB is required by law to determine if there is a need for further control. Recently, the ARB approved a Diesel Risk Reduction Plan (RRP) in consultation with the Advisory Committee on TACs from Diesel-fueled Engines and Vehicles. The Advisory Committee is made up of industry, environmental groups, other government agencies, and members of the public. Because of the timing of the Diesel RRP and the potential threat to public health from diesel particulate matter, stationary diesel-fueled engines are being addressed separately in a manner which takes into account the potential need to further control diesel PM and NOx simultaneously.

Emissions from diesel-fueled engines have the potential to pose significant cancer risks to the public working or living in close proximity to a diesel engine installation. It is possible that both NOx and PM emissions will need to be controlled from these engines. Unfortunately, many combustion modification techniques and technologies used to reduce NOx emissions can tend to increase PM emissions and vice versa. In addressing diesel-fueled engines, a balanced approach will be taken so that the maximum benefit to public health will be realized in reducing both pollutants. ARB staff is evaluating technologies that reduce PM emissions from diesel-fueled engines and the results from their evaluation will be considered in controlling emissions from stationary diesel-fueled engines. The effect on NOx emissions from these different technologies will also be evaluated in the document addressing diesel-fueled engines.

C. IC Engines used in Agricultural Operations

Also discussed previously, were the potentially significant emissions from the IC engines used in agricultural operations, particularly in the San Joaquin Valley. Although limited information is available, statewide NOx emissions from diesel-fueled engines used in stationary, nonroad, and portable agricultural applications have been estimated to be about 8,400 tons per year, which is about 28 percent of the emissions from stationary spark-ignited and diesel-fueled IC engines in the 1996 point source inventory. It is important to note that the majority of these engines are believed to be diesel-fueled with a smaller portion being natural gas-fueled SI engines. According to Health and Safety Code Section 42310(e), districts are prohibited from requiring permits for agricultural engines which accounts for the incomplete information and data on their engine population, operating hours, and emissions. Presently, these engines are not regulated, and their emissions are uncontrolled. However, the Health and Safety Code prohibition does not preclude districts from controlling the emissions from agricultural engines in some other manner. Appendix F provides a legal opinion on this issue.

In recent years, there has been a growing concern with the NOx and other emissions from these uncontrolled sources and their contribution to ozone. Because of the magnitude of the potential emissions from these engines, we recommend that districts develop alternatives to permitting for regulating these types of IC engines. An example of an alternative would be a voluntary approach such as the Carl Moyer program which provides incentives for owner/operators of internal combustion engines to repower with low emissions engines or to replace an existing engine with an electric motor. This type of program has demonstrated the potential to significantly reduce NOx emissions.

II. SUMMARY OF THE DETERMINATION FOR SPARK-IGNITED IC ENGINES

The provisions of this determination are applicable to all stationary, spark-ignited internal combustion engines with a manufacturer's rating of 50 brake horsepower or greater, or a maximum fuel consumption of 0.52 million Btu per hour or greater. This fuel consumption is equivalent to 50 brake horsepower using a default brake specific fuel consumption (BSFC) rating of 10,400 Btu per brake horsepower-hour. For different BSFC ratings, the maximum fuel consumption ratings should be adjusted accordingly.

The RACT and BARCT limits for NOx, VOC, and CO are summarized in Tables II-1 and II-2. Different limits apply to (1) spark-ignited rich-burn engines, (2) spark-ignited lean-burn engines, (3) rich-burn engines using waste gases, (4) cyclically-loaded rich-burn engines using field gas, and (5) two stroke lean-burn engines rated at less than 100 horsepower. Gasoline-fueled, spark-ignited engines are required to use California Reformulated Gasoline. The exemptions, administrative requirements, and test methods are listed at the end of this chapter.

A. Engines Rated Less Than 50 Horsepower

Most district rules exempt from permit and control requirements engines rated less than 50 horsepower. This document does not make a RACT/BARCT determination for this class of engines. If it is determined that these engines make a significant contribution to district-wide emissions, non-attainment Districts are encouraged to consider making a RACT/BARCT determination for these engines either as an entire subcategory or on a case-by-case basis. In considering this class of engines, ARB staff recommends that the districts evaluate the cost-effectiveness of controlling less than 50 hp engines.

B. Engines Derated to Less Than 50 Horsepower

This document does not make a RACT/BARCT determination for engines derated to less than 50 horsepower. A derated engine is one in which the manufacturer's brake horsepower rating has been reduced through some device that restricts the engine's output. In fact, most district IC engine rules apply to engines with a manufacturer's rating greater than 50 horsepower, regardless of any derating. Districts are encouraged to make a RACT/BARCT determination for these engines either as an entire subcategory or on a case-by-case basis.

ARB staff analysis identified several technically feasible approaches for reducing NOx emissions from engines derated to less than 50 hp. These approaches include electrification, air/fuel adjustments, and use of a catalytic control system. However, the cost effectiveness of implementing these technologies was highly dependent on site-specific considerations, including the proximity of power and the need to cleanup the gaseous fuel prior to making air/fuel adjustments or installing a catalyst.

As a result, ARB staff did not believe it was appropriate to make a <u>statewide</u> RACT/BARCT determination for the entire subcategory of engines derated to less than 50 hp. Instead, ARB staff recommends that the districts evaluate the cost-effectiveness of controlling engines derated to less than 50 horsepower and make a RACT/BARCT determination on either a district-wide or case-by-case basis. Please refer to Chapter IV for a more detailed discussion of this issue.

C. RACT Limits

For spark-ignited rich-burn engines, the RACT limits are expected to be achieved by using catalysts, prestratified charge systems, or by leaning the air/fuel mixture. The RACT limits for spark-ignited lean-burn engines are expected to be achieved by leaning the air/fuel mixture or by retrofitting with low-emission combustion controls to allow further leaning of the air/fuel mixture. Alternative approaches would be the retrofit of existing engines with parts used in newer engines designed for low NOx emissions, replacement of the existing engine with a state-of-the-art low-emissions engine fueled by natural gas or propane, or replacement with an electric motor. Examples of retrofit parts used in low emissions engines would include pistons, heads, electronic engine controllers and ignition systems. It may be necessary to check with the engine manufacturer concerning the compatibility of the components being for retrofit on an existing engine.

D. BARCT Limits

The BARCT limits for spark-ignited rich-burn engines fueled by waste gas are expected to be achieved by using prestratified charge systems. For spark-ignited rich-burn engines, the limits for fuels other than waste gases are expected to be achieved by using catalysts. The spark-ignited lean-burn limits are expected to be achieved by the retrofit of low-emission combustion controls, although some engines may require the use of selective catalytic reduction (SCR).

The BARCT limits reflect a cost-effectiveness threshold of $12 per pound of NOx reduced which is comparable to Sacramento Metropolitan AQMD's threshold of $12 per pound and the South Coast AQMD's threshold of $12.25 per pound. Although the cost-effectiveness for individual engines will generally be lower than $12 per pound, in some individual cases the cost-effectiveness could exceed this figure.

E. Engines with Common RACT and BARCT Limits

In addition, there are two categories of engines which are assigned identical RACT and BARCT limits due to conditions or situations which would make meeting the standard limits onerous. The RACT and BARCT limits for cyclically-loaded, field gas fueled engines used on oil pumps have been set at 300 ppm NOx due to the unique duty cycle of the engine, the character of the fuel which can contain significant amounts of sulfur and moisture, the variable Btu content of the fuel, and the difficulty in controlling emissions from a cyclically-loaded engine. It is expected that the limits for these rich-burn engines will be met by keeping the engines properly maintained and tuned, and by leaning the air/fuel mixture.

There is another category, which includes two-stroke engines fueled by gaseous fuel and rated at less than 100 horsepower. There are a limited number of these engines in use and there are no cost-effective controls available for these engines. The limits for these engines are expected to be achieved by properly maintaining and tuning these engines which would include replacing the oil-bath air filter with a dry unit and cleaning the air/fuel mixer and muffler on a regular basis.

These RACT and BARCT limits should be used as guidance. Districts have the primary responsibility for regulating stationary sources and have the flexibility to adopt IC engine rules that differ from this guidance, as long as these differences do not conflict with other applicable statutes, codes and regulations. The districts may adopt internal combustion engine rules after a case-by-case analysis of engines in the district in order to determine a technically feasible and cost effective way to reduce emissions taking into account site-specific situations or conditions. The districts' decisions on control technologies must not conflict with regulatory requirements and statutory obligations such as attainment plans.

The full text of the determination is provided in Appendix A. The technical basis for the emission limits can be found in Chapter IV.

Table II-1

Summary of RACT Standards for Stationary Spark-Ignited Internal Combustion Engines

Spark-Ignited Engine Type	% Control of NO_X	ppmv at 15% O_2 [1]		
		NO_X	VOC	CO
Rich-Burn				
Cyclically-loaded, Field Gas Fueled	--	300	250	4,500
All Other Engines	90	50	250	4,500
Lean-Burn				
Two Stroke, Gaseous Fueled, Less Than 100 Horsepower	--	200	750	4,500
All Other Engines	80	125	750	4,500

1. For NOx, either the percent control or the parts per million by volume (ppmv) limit must be met by each engine where applicable. The percent control option applies only if a percentage is listed, and applies to engines using either combustion modification or exhaust controls. All engines must meet the ppmv VOC and CO limits.

Table II-2

Summary of BARCT Standards for Stationary Spark-Ignited Internal Combustion Engines

Spark-Ignited Engine Type	% Control of NO_X	ppmv at 15% O_2[1]		
		NO_X	VOC	CO
Rich-Burn				
Waste Gas Fueled	90	50	250	4,500
Cyclically-loaded, Field Gas Fueled	--	300	250	4,500
All Other Engines	96	25	250	4,500
Lean-Burn				
Two Stroke, Gaseous Fueled, Less Than 100 Horsepower	--	200	750	4,500
All Other Engines	90	65	750	4,500

1. For NOx, either the percent control or the parts per million by volume (ppmv) limit must be met by each engine where applicable. The percent control option applies only if a percentage is listed, and applies to engines using combustion modification or exhaust controls. All engines must meet the ppmv VOC and CO limits.

ELEMENTS APPLICABLE TO BOTH RACT AND BARCT

Exemptions

- ? Engines operated during emergencies or disasters to preserve or protect property, human life, or public health (e.g., firefighting, flood control)
- ? Portable engines, as defined in Appendix A
- ? Nonroad engines, as defined by the United States Environmental Protection Agency (U.S. EPA), excluding nonroad engines used in stationary applications
- ? Engines not used for the distributed generation of electricity, if operated 200 or fewer hours per year
- ? Emergency standby engines that, excluding period of operation during unscheduled power outages, operate 100 or fewer hours per year

[**Note**: Engines used in agricultural operations are exempt from permitting by the districts according to Health and Safety Code Section 42310(e). However, this prohibition does not preclude districts from controlling agricultural engines in some other manner. Refer to Appendix F.]

Administrative Requirements

- ? Emission control plan
- ? Inspection and monitoring plan
- ? System to monitor NOx and O_2 continuously for engines >1,000 horsepower and permitted to operate >2,000 hours per year
- ? Source test every two years
- ? Monitor NOx and O_2 every three months using a portable NOx analyzer
- ? Conduct source testing and quarterly monitoring at an engine's actual peak load and under the engine's typical duty cycle
- ? Maintain records of inspections and continuous stack monitoring data for two years
- ? Maintain an operating log which shows, on a monthly basis, the hours of operation, fuel type, and fuel consumption for each engine
- ? Installation of nonresettable elapsed operating time meter
- ? Installation of nonresettable fuel meter or an alternative approved by the Air Pollution Control Officer

ELEMENTS APPLICABLE TO BOTH RACT AND BARCT
(continued)

Test Methods

- ? O_2: ARB Method 100 or U.S. EPA Method 3A
- ? NOx: ARB Method 100 or U.S. EPA Method 7E
- ? VOC: ARB Method 100 or U.S. EPA Method 25A or 25B
- ? CO: ARB Method 100 or U.S. EPA Method 10

Alternative test methods which are shown to accurately determine the concentration of NOx, VOC, and CO in the exhaust of IC engines may be used upon the written approval of the Executive Officer of the California Air Resources Board and the Air Pollution Control Officer.

Nonresettable fuel meters installed on stationary spark-ignited internal combustion engines shall be calibrated periodically per the manufacturers' recommendation. The portable NOx analyzer shall be calibrated, maintained, and operated in accordance with manufacturer's specifications and recommendations or with a protocol approved by the Air Pollution Control Officer.

III. SUMMARY OF SPARK-IGNITED IC ENGINE CONTROLS

The combustion of hydrocarbon fuels in IC engines results in emissions of the following criteria pollutants: NOx, CO, VOC, particulate matter, and sulfur oxides (SOx). The pollutant of primary concern from stationary IC engines in this determination is NOx. NOx is a criteria pollutant that reacts in the atmosphere to form ozone which is a significant air pollution problem in California.

There are probably more different types of controls available to reduce NOx from IC engines than for any other type of NOx source. These controls can be grouped into the following general categories: combustion modifications, fuel switching, post-combustion controls, and replacement of the engine with a new, low emissions engine or an electric motor.

Combustion modifications include ignition timing retard, optimization of the internal engine design, turbocharging or supercharging with aftercooling, exhaust gas recirculation, and leaning of the air/fuel ratio. In the case of leaning the air/fuel ratio, this is generally done in combination with other techniques, which allow extremely lean ratios. Fuel switching includes the substitution of methanol for natural gas. Post combustion controls include nonselective catalytic reduction and selective catalytic reduction. Low-emission combustion may use several combustion modifications such as precombustion chambers, turbocharging, and improved ignition systems to reduce emissions, and may also use fuel switching.

Table III-1 summarizes the applicability and effectiveness of the NOx control methods for stationary engines. Although control technologies are shown for NOx control, both CO and VOC emissions must meet their respective requirements. A more detailed description of controls for stationary IC engines can be found in Appendix B.

Table III-1
Summary of Primary NOx Controls For Stationary Spark-Ignited IC Engines

Control Technology	NOx Reduction Effectiveness
Combustion Modifications	
Ignition Timing Retard	15-30%
Prestratified Charge	80+%[1]
Low-emission Combustion	80+%[2]
Turbocharging or Supercharging With Aftercooling	3-35%
Exhaust Gas Recirculation	30%
Fuel Switching	
Methanol	30%[3]
Post-Combustion Controls	
Nonselective Catalytic Reduction	90+%[1]
Selective Catalytic Reduction	80+%[4]
Replacement with Low Emissions Engine Or Electric Motor	60-100%[5]

1. Applies to rich-burn spark-ignited (SI) engines.
2. When the air/fuel mixture is leaned and combined with other NOx reduction techniques (i.e., precombustion chamber, ignition system improvement, turbocharging, air/fuel ratio controller).
3. Applies to natural gas engines.
4. Applies to SI lean-burn engines.
5. For replacement with an electric motor, emissions are reduced 100 percent at the IC engine location, although emissions at power plants may increase.

IV. BASIS FOR DETERMINATION FOR SPARK-IGNITED IC ENGINES

A summary of the determination can be found in Chapter II. The full text of the determination can be found in Appendix A. This chapter will review the basis or reasons for the emissions limits, requirements, and exemptions included in the determination. In developing this determination, the ARB and air districts staff reviewed a number of reports on IC engines, emissions inventory data, vendor literature, source test data, district rules and accompanying staff reports, and other sources of information.

A. Applicability

This determination is applicable to stationary spark-ignited internal combustion engines that have a continuous power rating equal to or greater than 50 brake horsepower. The 50 horsepower cutoff is consistent with the majority of district IC engine rules. Neither a RACT nor BARCT determination was made for engines rated less than 50 horsepower. Districts may consider making a specific determination for this class of engines if their emissions are significant.

In some cases, an engine's power rating may be suspect or unknown. To assure that engines exceeding 50 brake horsepower are not exempt, spark-ignited engines with a maximum hourly fuel consumption rate above 0.52 million Btu per hour are also subject to controls. This fuel consumption level corresponds to engines rated at approximately 50 brake horsepower using a default BSFC rating of 10,400 Btu per brake horsepower-hour. For different BSFC ratings, the maximum fuel consumption ratings should be adjusted accordingly.

1. Engines Derated to Less Than 50 Horsepower

Neither a RACT nor a BARCT determination was made on stationary spark-ignited IC engines derated to less than 50 horsepower due to insufficient, and in some cases, conflicting data. A derated engine is one in which the manufacturer’s brake horsepower rating has been reduced through some device which restricts the engine’s output. One of the largest categories of the derated engines are cyclically-loaded units used to drive reciprocating oil pumps. These engines are generally fueled by oil field gas with variable energy content and composition which may include moisture, hydrogen sulfide and other compounds. The cyclic load on these engines may have a cyclic period of less than 10 seconds. These characteristics would tend to discourage the use of catalysts with air-to-fuel controllers. However, it is interesting to note that a review of source test data in the text of Sections C and D of Chapter IV, Table IV-1 and Appendix D indicates that there have been instances where these engines have been successfully controlled in the past by cleaning up the field gas, and “leaning-out” the engine or installing a catalyst in some cases.

In the case of field gas-fueled engines driving beam-balanced and crank-balanced oil pumps, there are a variety of issues which can affect the approach used to control emissions. The fuel quality and composition of the field gas varies from area to area so that one engine may require treated fuel while another doesn’t. The installation of a gas processing plant may be costly and would affect the cost effectiveness of controlling the emissions from these engines. In addition, consideration should also be given to the number of wells feeding the plant, the proximity of the wells to the plant, and the cost of setting up a gas collection and distribution system for the fuel. An alternative approach is electrification. The majority of the beam-balanced and crank-balanced oil pumps in California are driven by electric motors. This would certainly be an effective approach if electric power is reasonably accessible. However, since some of these engines may be remotely located, the cost of bringing in electrical power could be onerous. Finally, there is a lack of data on certain control technologies which may be effective in reducing emissions from cyclic and non-cyclic engines fueled by field gas with significant amounts of moisture and hydrogen sulfide. Because of the variety of factors that can affect the feasibility and cost-effectiveness of controlling this category, we were unable to make a categorical determination. We recognize that there are technologies (i.e. electrification, cleaning up the field gas and controlling the engine by leaning the air/fuel mixture or adding a catalyst) that can be used to control the emissions from these engines. However, the costs associated with implementing these controls may be cost prohibitive depending on site-specific considerations. We recommend that the districts handle this type of derated engine on a categorical or case-by-case basis due to the uniqueness of the different installations.

Districts may consider controlling the emissions from other categories of derated engines if they determine that it is technically feasible and cost effective. Engines with lower horsepower ratings may be difficult to control due to lack of available emission controls, the relatively high cost of emission controls (especially when compared to the cost of the engine), cost effectiveness, site-specific conditions and other considerations such as operating mode and fuel type. Districts should take these factors into consideration. In addition, repowering with either electric motors or new low-emissions engines should also be considered as alternatives.

Technology development and innovation may also aid in the feasibility of controlling engines derated to less than 50 horsepower. Recently the California Air Resources Board adopted regulations for new small off-road engines and new large off-road spark-ignited engines which included engines rated at less than 50 horsepower. In the rulemaking effort for the large spark-ignited off-road engines, it was concluded that it was feasible and cost effective to control engines rated at 25 horsepower and greater with an air-to-fuel ratio controller and a three-way catalyst also known as non-selective catalytic reduction. Technologies used to control mobile engines certainly have the capability to be used in stationary applications.

B. Alternative Form of Limits

Where applicable, the determination provides a choice of two NOx alternatives: operators must meet either a percent reduction or an emissions concentration limit in parts per million by volume (ppmv). Use of the percentage reduction option may be applied to engines using add-on control devices that treat the exhaust gas stream, engine modifications, or fuel switching. One reason for this NOx control alternative is that exhaust controls typically reduce NOx by a certain percentage, regardless of the initial NOx concentration. Thus, for engines inherently high in NOx, the emission concentration limit may be difficult to achieve when using exhaust controls. Providing an emission limit and percent reduction option allows engine owners or operators a greater degree of flexibility in choosing controls and complying with the emission limits.

In using the percentage reduction option, determining compliance when exhaust controls are used is relatively straightforward, as NOx concentrations can be measured before and after the control device. In contrast, for controls based on engine changes or fuel changes, it is more difficult to determine an accurate percentage reduction. Baseline concentrations must be established by conducting source testing prior to the installation of the engine or fuel modifications. The baseline concentrations will be a function of engine operating parameters such as air/fuel ratio, ignition timing, power output, and the engine duty cycle. When baseline concentrations are being established, it is recommended that the engine operating parameters be thoroughly documented along with the load and the duty cycle under which the engine normally operates. This is done so that the engine can be checked to ensure that it is operating under similar conditions when post-modification source testing is conducted. In this case, compliance is determined by comparing the baseline NOx concentration with the post-modification concentration, estimating a percent NOx reduction and verifying that the control meets the appropriate percent reduction limit.

Except for the optional percentage reduction for NOx, the determination uses limits expressed in parts per million by volume (ppmv). These limits could have been expressed in units of grams per brake horsepower-hour. However, use of limits in terms of grams per brake horsepower-hour would require engines to be simultaneously tested for emissions and horsepower. This would increase costs for compliance verification, and for that reason limits expressed in terms of grams per brake horsepower-hour are not recommended.

C. RACT NOx Limits

It is generally understood that RACT is the application of demonstrated technology to reduce emissions. "Demonstrated" means a particular limit has been achieved and proven feasible in practice. This demonstration need not take place in California. The demonstration also need not be performed on every make and model of IC engine, as long as there is a reasonable likelihood that the technology will be successful on these other makes and models. In addition to the control options discussed below, other options for meeting RACT are discussed in Section F of this chapter. These options include repowering with either a new controlled engine or an electric motor.

1. Rich-Burn Engines

The RACT emission limits for spark-ignited rich-burn engines not cyclically-loaded are based on Ventura County APCD’s Rule 74.9 that was in effect between September 1989 and December 1993 (this rule was superseded by a more effective version of Rule 74.9 in December 1993). The 1989-1993 version of this rule required all affected engines to meet applicable limits by 1990. For natural gas-fired rich-burn engines, this NOx limit is 50 parts per million by volume (ppmv), corrected to 15 percent oxygen and dry conditions. Alternatively, rich-burn engines can meet a 90 percent NOx reduction requirement.

The Ventura County rule allowed the emission limits to be increased for engines exhibiting efficiencies greater than 30 percent. However, there are few cases where such efficiency adjustments would increase the allowable emissions significantly. For example, natural gas-fired engines rarely exceed the mid-30s in percentage efficiency, and most of these engines probably are less than 30 percent efficient. In addition, districts that include an efficiency adjustment in their IC engine rules have rarely found a need to use this adjustment to meet rule requirements. This determination does not include an efficiency adjustment. Such an adjustment increases the complexity of the determination, and would complicate enforcement. In many cases, it is difficult to determine the efficiency of an engine. The manufacturer's rated efficiency could be used, but in some cases this information may not be available. Even if this information is available, the efficiency of an engine in the field may differ significantly from the manufacturer's rating due to differences in air density, temperature, humidity, condition of the engine, and power output. The RACT emissions limits can be met without an efficiency adjustment if controls are properly designed, maintained, and operated.

Appendix D summarizes recent source tests from Ventura County for the years 1994 through 1997. Results of source tests for 1986 through 1997 on rich-burn engines are compared to the Ventura IC engine rule applicable at the time (i.e., 50 ppmv NOx or 90 percent reduction). Included in this database were a dozen tests on engines to determine baseline values or emission reduction credits. These engines were not controlled and were not required to meet the rule's emissions limits. Excluding tests conducted to determine baseline values or emission reduction credits leaves over 1000 tests on rich-burn engines. Only about 8 percent of these tests exceeded the applicable NOx limit. In the majority of cases, engines that violated the limit passed other source tests before and after the violation. No particular engine make or model appeared to have a significant problem in attaining the applicable NOx limit. These source tests covered almost sixty different models of engines made by eight different manufacturers.

From the mid-1980s to the mid-1990s, approximately 280 of 360 stationary engines were removed from service in Ventura County. Many of these engines were first retrofitted with controls and were in compliance when they were removed. Though Ventura County's IC engine rule may have contributed to the reduction in the number of stationary IC engines, other areas of the State that did not have a rule controlling NOx emissions from existing stationary engines also experienced significant reductions in stationary engines during the same time period. Most of these engines were used in oil and gas production activities. This reduction in numbers may reflect an overall general reduction in oil and gas production in the State. It may also reflect the impact of new source review. New source review is a collection of emissions and mitigation requirements that must be met before a new or existing stationary source of emissions can be built or modified in the State. New source review may have encouraged the use of electric motors rather than IC engines for new or modified production activities. In addition, new source review may have encouraged the shutdown or replacement of existing IC engines to generate emissions offsets for new or modified production activities.

Based on these data, it appears that the RACT emission levels for rich-burn engines not cyclically-loaded are achievable for a wide variety of gaseous-fueled engines.

It is expected that the most common control method to be used to meet the RACT limits for rich-burn engines not cyclically-loaded will be the retrofit of NSCR controls. For rich-burn engines using waste-derived fuels, where fuel contaminants may poison the catalyst, the most common control method is expected to be the use of prestratified charge controls.

Cyclically-loaded (cyclic) engines including those driving the beam-balanced or crank-balanced oil pumps and fueled by oil field gas have characteristics that may affect the effectiveness of controls. These characteristics include low exhaust gas temperatures (since the engines spend significant periods of time at idle) and rapid fluctuations in power output. The oil field gas may contain significant amounts of moisture and sulfur which may lead to the formation of sulfuric acid which can damage catalysts. The energy content of field gas may vary affecting engine performance. Because of the difficulties and potential costs associated with controlling the emissions from field gas-fueled IC engines driving the beam-balanced and crank-balanced reciprocating oil pumps, the emission limits for these engines are based on San Joaquin Valley Unified APCD's Rule 4701. For beam-balanced or crank-balanced pumping engines, the NOx limit is 300 ppmv corrected to 15 percent oxygen. It is expected that this limit for these rich-burn engines will be met by keeping the engines properly maintained and tuned, and by leaning the air/fuel mixture. We recommend that the districts require the replacement of these engines at the end of their useful life with prime movers having lower NOx emissions.

There have been situations where cyclic rich-burn engines have met the RACT limits of 50 ppmv either by using NSCR or by leaning the air/fuel mixture in conjunction with treating the field gas to reduce the moisture and sulfur content. Both of these control methods have been used successfully on cyclic engines used on "grasshopper" oil well pumps in Santa Barbara County. Source tests of NSCR-equipped cyclic engines in Santa Barbara County have shown that these engines can be effectively controlled with or without air/fuel controllers provided the oil well pumps are air-balanced units. The oil field gas in this particular situation is naturally low in sulfur or "sweet." In the case of beam- and crank-balanced rod pumps, the air/fuel ratio controllers that are part of the control system have slow response times relative to the load fluctuations, making NSCR ineffective due to the low exhaust temperatures. For the beam- and crank-balanced oil well engines, the air/fuel ratio must be leaned along with treating the field gas to meet the NOx limits. Table IV-1 summarizes the results of source tests on cyclically operated engines in Santa Barbara County. These tests were conducted from 1992 through 1995. All engines at Site A used NSCR on engines driving air-balanced oil pumps to control NOx emissions. All engines at other sites used leaning of the air/fuel mixture to control NOx. In addition, it is important to note that the field gas used at the sites referenced in Table IV-1 was either naturally low in sulfur or treated to pipeline-quality natural gas. These engines represent two different manufacturers and six different models. In Ventura County, there are another eight of these rich-burn engines fueled by treated field gas which drive beam-balanced and air-balanced rod pumps. NSCR is installed on all of these engines with five meeting a limit of 50 ppmv NOx and three meeting 25 ppmv.

Table IV-1
Summary of NOx Source Testing of Cyclically Operated Engines
Santa Barbara County

Emissions in ppmv

Site	Engines	Tests	Engine Size	Operating Capacity	NO_X	CO	VOC
A	18	5	195 hp	50-75%	2-14	79-2445	2-35
B	4	9	131 hp	20-40%	12-35	165-327	29-552[1]
C	16	16	39-46 hp	43-112%	8-28	129-291	25-98
D	18	28	39-49 hp[2]	30-75%	7-33	154-406	31-196

1. One engine exceeded the 250 ppmv VOC limit. After repairs, this engine was retested 6 weeks later and was found to be in compliance.
2. Two engines were derated.

Because of the demonstrated success of meeting the 50 ppmv NOx limit for cyclic rich-burn engines fueled by low-sulfur or treated field gas, we recommend that the districts consider the cost effectiveness of field gas treatment and emission controls in setting limits for these engines on a site-specific basis. In situations where this approach exceeds the cost effectiveness threshold of $12 per pound, we would recommend that districts set a limit of 300 ppm NOx and require the replacement of these engines at the end of their useful life with IC engines having lower NOx emissions or electric motors. In performing the cost effectiveness analysis for treating the field gas and the emission control, the additional costs for field gas treatment should be included along with the incremental materials and labor cost associated with piping the treated gaseous fuel back to the engines from the gas processing unit. Naturally, any costs, benefits, or profits realized from selling the gas should also be included in the analysis.

2. Lean-Burn Engines

The basis for the RACT emission limits for four-stroke spark-ignited lean-burn engines and two-stroke spark-ignited engines rated at 100 horsepower or more is the same as for rich-burn engines: Ventura County APCD's Rule 74.9 that was in effect between September 1989 and December 1993. For natural gas-fired lean-burn engines, this NOx limit is 125 ppmv, corrected to 15 percent oxygen and dry conditions. Alternatively, these lean-burn engines can meet an 80 percent NOx reduction requirement.

Appendix D summarizes a large number of source tests from Ventura County from the years 1994 through 1997. Results of source tests from 1986 through 1997 on lean-burn engines were compared to the limits of Ventura County's IC engine rule applicable at the time (i.e., 125 ppm NOx or 80 percent reduction). Excluding tests conducted to determine baseline values or emission reduction credits, there were 358 tests on lean-burn engines. Only 21 (approximately 6 percent) of these tests exceeded the applicable NOx limit. In most cases, engines that violated the limit passed several other source tests before and after the violation. No particular engine make or model appeared to have a significant problem in attaining the applicable NOx limit. These source tests covered nineteen different models of engines made by nine different manufacturers.

Based on these data, we conclude that the RACT emission levels for four-stroke lean-burn engines and two-stroke engines rated at 100 horsepower and greater are achievable for a wide variety of gaseous-fueled engines.

We expect the most popular control method used to meet the RACT limits for these lean-burn engines will be the retrofit of low-emission combustion modifications. These modifications will probably include the retrofit of precombustion chambers. In cases where these modifications have not been developed for a particular make and model of engine, SCR may be used as an alternative.

A separate NOx limit of 200 ppmv is set for gaseous-fueled, two-stroke lean-burn engines rated at less than 100 horsepower. This limit is based on recent source test data. There are a relatively small number of these engines which are located in gas fields statewide and are used to drive compressors at gas wells. While precombustion chambers or low-emission combustion retrofits would control emissions from this engine type, there are none available on the market and the cost to develop a retrofit for a limited number of engines would be cost prohibitive. As a result, the only cost-effective way to control emissions from the small two-stroke engines is by properly maintaining and tuning these engines which includes replacing oil-bath air filters with dry units and periodically cleaning the air/fuel mixer and muffler. We recommend that the districts require the replacement of these engines at the end of the two-stroke engine's useful life with prime movers having lower NOx emissions.

D. BARCT NOx Limits

A summary of the BARCT determination can be found in Chapter II. The full text of the BARCT determination can be found in Appendix A.

The Health and Safety Code Section 40406 defines BARCT as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source." Control technology must be available by the compliance deadline that has achieved or can achieve the BARCT limits, but these limits do not necessarily need to have been demonstrated on IC engines. A technology can meet the definition of BARCT if it has been demonstrated on the exhaust gases of a similar source, such as a gas turbine, and there is a strong likelihood that the same technology will also work on exhaust gases from IC engines and that systems designed for IC engines are available from control equipment vendors. In addition to the technologies cited below, there are additional candidates described in Appendix B which potentially could be considered to be BARCT. Finally, it is important to note that South Coast AQMD requires owner/operators of stationary engines to comply with Rule 1110.2 by offering them the choice of reducing the engines emissions to specified limits, removing the engine from service, or replacing the engine with an electric motor. Electrification is another approach to consider and is discussed along with other control options in Section F of this chapter.

1. Rich-Burn Engines

The BARCT emission limits for rich-burn engines not cyclically-loaded are based on the current version (adopted December 1993) of Ventura County APCD's Rule 74.9, the Federal Implementation Plan for the Sacramento area, and the Sacramento Metropolitan Air Quality Management District's Rule 412. These NOx limits are 25 ppmv or 96 percent reduction for most rich-burn engines, and 50 ppmv or 90 percent reduction for rich-burn engines using waste gases as fuel. Best available control technology (BACT) determinations of the South Coast AQMD and ARB's BACT Clearinghouse meet or exceed the BARCT limits.

The Ventura County source test data referenced earlier (page IV-2) indicates that about 65 percent of the tests (i.e., 623 out of 962 tests) on rich-burn engines operating on natural gas or oil field gas met the BARCT NOx limit of 25 ppmv or 96 percent NOx reduction. These engines used either NSCR type catalysts or prestratified charge controls. Engines using prestratified charge controls met the limit less often (21 percent, or 32 out of 153 tests) than engines using catalysts (73 percent, or 591 out of 809 tests). The controls for these rich-burn engines were designed to meet a 50 ppmv or 90 percent reduction limit, not the 25 ppmv or 96 percent NOx reduction limit as in the BARCT determination. Better NOx emission reduction performance can be anticipated if controls are designed to meet a 25 (rather than 50) ppmv limit.

There is a separate BARCT NOx limit for rich-burn engines fueled by waste gases (e.g., sewage digester gas, landfill gas). This limit, 50 ppmv or 90 percent reduction, is the same as the RACT limit for rich-burn engines. A review of source tests of rich-burn engines using waste gases indicate a high percentage of the engines complied with a 50 ppmv NOx limit. In addition, identical NOx limits are contained in Ventura County APCD’s Rule 74.9. Comparable limits are included in IC engine rules for South Coast AQMD and Antelope Valley APCD. The waste gas engines that were tested used prestratified charge controls because the application of NSCR to waste gas fueled engines has often been unsuccessful. NSCR catalysts often have problems with plugging and deactivation from impurities in waste gases. In order to use a catalyst, the waste gas should be treated to remove these impurities. This gas treatment process could be a substantial additional cost in controlling the emissions from this class of engines.

It is expected that the most popular control method used to meet the BARCT limits for rich-burn engines not cyclically-loaded using fuels other than waste gases will be NSCR with air/fuel ratio controllers. For engines using waste gases, the use of prestratified charge controls are expected to be the most popular control method.

For cyclic rich burn engines, the discussion and recommendations for RACT NOx limits apply for BARCT NOx limits as well. Due to the difficulties and costs associated with controlling the emissions from these engines, the NOx limit is set at 300 ppmv which is based on San Joaquin Valley Unified APCD’s Rule 4701. We recommend that the districts require the replacement of these engines at the end of their useful life with prime movers having lower NOx emissions. It is expected that this limit will be met by keeping the engines properly maintained and tuned, and by leaning the air/fuel mixture. However, there are situations where it has been feasible to control the emissions from these engines. A review of 34 source tests on 26 cyclic rich burn engines fueled by low-sulfur field gas and driving air-balanced oil well pumps in Santa Barbara County APCD demonstrated that all engines were able to meet the 25 ppm NOx limit by using NSCR. In the case of the “leaned-out”engines fueled by treated field gas and driving beam-balanced and crank-balanced oil wells, the source tests indicate that 81 percent of the source tests met the limit. In setting limits for cyclic rich-burn engines fueled by field gas, we recommend that air districts consider whether the field gas is “sweet” or if it is cost effective to treat the field gas to reduce the moisture and sulfur content and enable the usage of emissions controls. Districts should also consider the cost effectiveness of electrification of these oil pumps to reduce emissions. As mentioned previously, South Coast AQMD in Rule 1110.2 requires owner/operators of stationary engines to reduce the emissions to meet limits, remove the engines from service, or replace the engines with electric motors. Even in remote areas without access to the power grid, South Coast AQMD requires owner/operators of oil pumps to treat the field gas which fuels an IC engine genset with NSCR after-treatment. The genset supplies power to motors driving the beam-balanced and crank-balanced oil pumps contiguous to the genset.

For engines not cyclically-loaded, NSCR can be used to meet the 25 ppmv NOx limit by increasing the size of the catalyst bed along with the amount of active materials in the catalysts, and more precise air/fuel ratio controllers. In addition, closer tolerances, more frequent inspections, an increase in catalyst replacement frequency, and monitoring of a greater number of parameters under the facility’s inspection and monitoring plan could be required to maintain the higher performance required to meet the BARCT limits. The inspection and monitoring plan is discussed in Section I, Inspection and Monitoring Program.

2. Lean-Burn Engines

The BARCT emission limits for four-stroke spark-ignited lean-burn engines and two-stroke spark-ignited engines rated at 100 horsepower or greater are based on the current version (adopted December 1993) of Ventura County APCD's Rule 74.9, the Federal Implementation Plan for the Sacramento area, and the Sacramento Metropolitan Air Quality Management District's Rule 412.

We have specified a 65 ppmv or 90 percent reduction level as the BARCT NOx limit. This level is identical to the level in the Federal Implementation Plan for the Sacramento area, and is also identical to the level found in Sacramento Metropolitan AQMD's Rule 412. This level is less effective than the current Ventura County APCD's Rule 74.9 NOx limit of 45 ppmv or 94 percent control. However, the Ventura County APCD's limit includes an efficiency correction that can allow a NOx ppmv limit higher than 45. Our determination does not include an efficiency correction. In addition, only 40 percent of the Ventura County APCD’s source tests (143 of 358 tests) showed compliance with a 45 ppmv or 94 percent control NOx limit. On the other hand, the Ventura County APCD’s source test data show that approximately 70 percent of the source tests (249 of 358) for lean-burn engines met a NOx limit of 65 ppmv or 90 percent reduction. It is interesting to note that at the time of these source tests these engines were required to meet a less effective limit of 125 ppmv or 80 percent reduction under a previous version of Rule 74.9. The NOx reduction performance for engines using controls designed to meet the BARCT limit is expected to be better than that indicated by the Ventura County source test data.

It is expected that the most common control method used to meet the BARCT emission limit for four-stroke spark-ignited lean burn engines and two-stroke spark-ignited engines rated at 100 horsepower or more will be the retrofit of low-emission combustion controls. Other techniques may also be used to supplement these retrofits, such as ignition system modifications and engine derating. For engines that do not have low-emission combustion modification kits available, SCR may be used as an alternative to achieve the BARCT emission limits.

For two-stroke engines rated less than 100 horsepower, the discussion and recommendations for RACT NOx limits apply for BARCT NOx limits as well. There are relatively few of these small engines located in the state. In addition, emission controls for these engines are not available, and the cost to develop a retrofit for a limited number of engines could be expensive. As a result, the only cost-effective way to control emissions from the small two-stroke engines is by properly maintaining and tuning these engines which includes replacing oil-bath air filters with dry units and cleaning the air/fuel mixer and muffler on a regular basis. Recent source test data indicate that almost 90 percent of the small two-stroke gas field engines tested met the NOx limit of 200 ppmv. We recommend that the districts require the replacement of these engines at the end of their useful life with prime movers having lower NOx emissions.

E. Common Limits

Both the RACT and BARCT determinations include identical limits for CO and VOC. The basis for these common emissions limits is discussed below. Other elements that are identical include alternatives to controlling engines and exemptions which are addressed in Sections F and G.

1. CO Limits

The determination's limit for CO is 4,500 ppmv. This 4,500 ppmv limit is based on the highest CO limit in any district IC engine rule in California. Most districts have a 2,000 ppmv CO limit. The 4,500 ppmv CO limit in the determination was chosen since the main concern for emissions from IC engines has been on NOx, and some controls for NOx tend to increase CO emissions. The 4,500 ppmv CO limit should allow the determination's NOx limits to be met more easily and economically. In most cases, the determination's NOx limits will be met either by the use of three-way catalysts or a leaner air/fuel mixture. Either of these techniques should readily achieve a CO level of 4,500 ppmv.

In general, vehicles have been found to be the major source of CO in areas that are nonattainment for CO, and stationary sources do not contribute significantly to the nonattainment status. However, areas that are nonattainment for CO should assess the impact of stationary engines on CO violations, and should consider adopting a lower CO limit than 4,500 ppmv.

2. VOC Limits

VOC limits are included in the determination because VOC emissions, like NOx emissions, are precursors to the formation of ozone and particulate matter. VOCs are hydrocarbon compounds that exist in the ambient air and are termed “volatile” because they vaporize readily at ambient temperature and pressure. In addition, many VOCs are considered to be toxic and are classified as Toxic Air Contaminants (TAC) or Hazardous Air Pollutants (HAP). For stationary engines, the mass and impact of VOC emissions is lower than NOx emissions. However, several NOx controls tend to increase VOC emissions. The determination's VOC limits are designed to assure that VOC increases from NOx controls do not become excessive.

In addition, the determination's VOC limits help assure that engines are properly maintained. If an engine is misfiring or has other operational problems, VOC emissions can be excessive.

The determination’s limit for VOC is 250 ppmv for rich-burn engines and 750 ppmv for lean-burn engines. The 250 ppmv limit for rich-burn engines is readily achievable through the use of three-way catalysts or other NOx control methods involving leaning of the air/fuel mixture. A higher limit is for lean-burn engines, as VOC concentrations tend to increase when such engines are operated at the extremely lean levels needed to achieve the determination's NOx limits. These VOC limits are equal to the highest limits included in any district IC engine rule in California.

In cases where a district requires further VOC reductions to achieve the ambient air quality standards, the adoption of VOC limits more effective than those in the determination should be considered. More effective VOC limits on lean-burn engines can be achieved through the use of oxidation catalysts without impacting NOx reduction performance. Oxidation catalysts reduce VOC and CO emissions from lean-burn engines. See Appendix B for more information on oxidation catalysts.

F. Other Control Options

In addition to combustion modifications, exhaust controls, and use of alternative fuels, other control options can be used to meet the RACT and BARCT limits.

All RACT and BARCT limits can also be met by replacement of the IC engine with an electric motor or a new controlled engine. Although engine replacement does not qualify as “retrofit,” the California Clean Air Act provides that districts can take this approach under “every feasible measure” if districts are having difficulty attaining the State ambient air quality standard. In the case of an engine repower, the new controlled engine would use combustion modifications, exhaust controls, or an alternative fuel similar to an existing retrofitted engine. However, since the engine is new, greater design flexibility is usually available to engineer a more efficient engine and effective control package.

For some engines, another option for meeting the RACT and BARCT limits is to convert a rich-burn engine into a lean-burn engine, or a lean-burn engine into a rich-burn engine. In the case of engines converted to lean-burn, improved engine efficiencies may reduce overall costs compared to controlling the rich-burn engine. In the case of engines converted to rich-burn, the rich-burn controls may be much lower in cost than the lean-burn controls.

It is the intent of this determination to maximize emission reductions. Consequently, owner/operators of rich-burn engines are not allowed to convert these engines to a lean-burn configuration in order to be subject to the less effective NOx emission limits. For rich-burn to lean-burn conversions or vice versa, the more stringent rich-burn NOx limits apply. For instance, in the case of a rich-burn engine converting to a lean-burn unit, the rich-burn limits would apply since emission reductions would be maximized. Likewise, the rich-burn NOx limits would apply for a lean-burn to rich-burn conversion. It should be noted that districts may consider these types of conversions to be modifications, which may fall under New Source Review and trigger best available control technology and offset requirements. We would recommend consultation with the appropriate district prior to undertaking one of these conversions.

In addition, market-based programs allowing the buying and selling of emission reduction credits are another approach that can be used to comply with BARCT requirements. Pursuant to Health and Safety Code, Section 40920.6.(c), a source subject to BARCT may retire marketable emission reduction credits in lieu of a BARCT requirement. Health and Safety Code, Section 40920.6.(d) allows alternative means of producing equivalent emission reductions at an equal or less dollar amount per ton reduced, including the use of emission reduction credits, for any stationary source that has demonstrated compliance costs exceeding an established cost-effectiveness value per unit of pollutant reduced for any adopted rule.

In the South Coast Air Quality Management District (SCAQMD), sources of NOx and SOx that emit greater than 4 tons per year are regulated through a separate market trading program, the Regional Clean Air Incentives Market or RECLAIM. RECLAIM allows these sources to achieve equivalent or greater emission reductions as would have been required otherwise under BARCT. Excess reductions from one RECLAIM facility can be traded to other RECLAIM facilities or permanently retired for an air quality benefit. Stationary internal combustion engines that are regulated under RECLAIM are exempt from the District's NOx/SOx limits. However, these sources must still comply with the limits for other regulated pollutants covered under district rules. Therefore, stationary engines regulated under RECLAIM for NOx and SOx would still need to comply with the CO and VOC limits specified in Rule 1110.2.

G. Exemptions

1. Engines Used During Disasters or Emergencies

Engines are exempt from the determination when used during a disaster or state of emergency, provided that they are being used to preserve or protect property, human life, or public health. Such disasters or states of emergency can be officially declared by local, State, or Federal officials or by an individual if it is determined that property, human life, or public health could be adversely affected without the operation of the applicable engine. Reasons for including this exemption are obvious. If controls fail on an engine used during a disaster, without this exemption the operator is faced with fines for noncompliance if operations continue, or the loss of property, human life, or public health if the engine is shut down. Another situation where this exemption would apply would be the operation of an engine where the emission controls result in a degradation in the power output or performance. It would be considered acceptable to shutdown or disengage the emission controls if that action increases the engine power output and thereby would either prevents or decrease the possibility of the loss of property, human life, or public health which would otherwise occur with the derated engine. Exempting engines under these conditions eliminates the operator dilemma of choosing between the protection of air quality and the more immediate concerns of protecting human life, public health, and property.

2. Portable Engines

A portable engine is defined as one which is designed and capable of being carried or moved from one location to another according to Health and Safety Code, Section 41751. An engine is not considered portable if the engine is attached to a foundation or will reside at the same location for more than 12 consecutive months. This determination exempts portable engines whether they are registered under the Statewide Portable Equipment Registration Program or with a district. The statewide program is authorized under Health and Safety Code Sections 41750 through 41755 which require the ARB to develop a registration program and emissions limits for portable engines (see Chapter VII). Owners or operators of portable engines who decide to take part in this voluntary registration and control program are exempt from meeting the requirements of district rules and regulations.

3. Nonroad or Offroad Engines

To avoid potential conflicts with federal law, the determination exempts nonroad engines. Under the federal Clean Air Act Amendments of 1990, districts are prohibited from adopting emission standards or control technology requirements for all nonroad engines. However, for some categories of nonroad engines, control can be delegated to the ARB. See Chapter VII for further details. It should be noted that nonroad engines used in stationary applications are not exempt from this determination. In addition, engines used in nonroad applications are not considered “nonroad” if the engine remains at a location for more than 12 consecutive months or a shorter period of time for an engine located at a seasonal source.

4. Engines Operated No More Than 200 Hours Per Year

Engines that are not used for distributed generation of electrical power are exempt if they operate 200 hours or fewer per year. Most districts specify 200 hours as the limit for the low-usage exemption in their IC engine rules. Engines in this category are required to have a nonresettable fuel meter and a nonresettable elapsed operating time meter. The owner or operator may use an alternative method or device to measure fuel usage provided that the alternative is approved by the Air Pollution Control Officer.

Distributed generation refers to the practice where an IC engine is operated to produce electrical power, and this power is either fed into the electric utility grid or displaces utility electric power purchased by an industrial or commercial facility. An example of the latter situation is called “peak shaving” where an IC engine genset is operated during periods of high electrical rates, and the electrical power produced by a genset is cheaper than the power from the grid. Distributed generation also refers to the operation of an IC engine that is part of a mechanical drive system (e.g., water pump, conveyor belt) consisting of at least one IC engine and one electric motor, where the system can be powered either by the electric motor(s) or the IC engine(s).

IC engines used for distributed generation are not exempt, regardless of the number of hours of operation per year. The reason for this restriction is to assure that exempt engines will not operate simultaneously on some of the highest ozone days of the year (see the following discussion on the emergency standby engine exemption).

5. Emergency Standby Engines

The exemption for emergency standby engines is limited to engines operating no more than 100 hours per year, excluding emergencies or unscheduled power outages. Emergency standby engines are typically operated for less than an hour each week to verify readiness. Additional operation may be periodically required for maintenance operations. A limit of 100 hours per year allows a reasonable number of hours for readiness testing, maintenance and repairs. Engines in this category are required to have a nonresettable fuel meter and a nonresettable elapsed operating time meter. The owner or operator may use an alternative method or device to measure fuel usage provided that the alternative is approved by the Air Pollution Control Officer.

The definition of emergency standby engine excludes engines that operate for any other purpose than emergencies, unscheduled power outages, periodic maintenance, periodic readiness testing, readiness testing during and after repairs, and scheduled power outages for maintenance and repairs on the primary power system. The purpose of these limitations is to assure that these engines do not operate during nonemergencies to displace or supplement utility grid power for economic reasons such as distributed generation, “peak shaving,” or as part of an interruptible power contract or voluntary load reduction program with an electric power utility.

The current electric utility restructuring that is occurring in California changes the pricing of electricity and the incentives applicable to commercial and industrial facilities. Under restructuring, commercial and industrial customers are able to purchase electricity on the spot market. Spot prices are relatively low during the night, but much higher when the demand for power is at a peak. This peak is typically on hot summer days, when some of the highest ozone concentrations of the year are recorded.

Under restructuring, commercial and industrial facilities have the potential to generate and sell power from their emergency generator engines, and send this power to the electrical grid. Restructuring also allows such facilities to bid a reduction in their electrical demand, and operate emergency generator engines to supplement their grid power purchases. Thus, if the price of electricity is high enough there is an economic incentive for a facility to operate its own emergency generators, and either feed this power into the electrical grid or reduce the facility's demand for power.

Because all facilities within a district simultaneously experience these high electrical prices, the potential is significant for the simultaneous operation of a large number of engine generators, even if such usage is limited to only a few hours per year. If a large number of facilities in a district operate their emergency generators simultaneously, the increase in NOx emissions within the district could be substantial. These increases would occur on the hottest days of the year, which are typically the highest ozone days of the year. Thus, unless the nonemergency operation of emergency generators is restricted, the potential to impact peak ozone concentrations could be significant.

To minimize this impact on air quality, the determination prohibits the nonemergency operation of emergency engines to generate electrical or mechanical power so as to reduce a facility's electrical power consumption from the grid or to realize an economic benefit. Examples of the latter would include operation under an interruptible power contract or voluntary load reduction program, or for purposes of "peak shaving." In addition, emergency engines cannot be used to supply electrical power to the grid or for distributed generation.

6. Other Exemptions

Other exemptions may be justified under certain circumstances, but the inclusion of any additional exemption in a district rule should be fully justified. Before an exemption is added, the district should also investigate whether alternative, less effective controls should be required for a class of engines instead of totally exempting such engines from all control or testing requirements. Factors that should be considered include the need to adopt a RACT or BARCT level of control to meet air quality plan or Health and Safety Code requirements, and cost-effectiveness for a particular engine category.

H. Compliance Dates

For engines subject to RACT or BARCT limits, an application for a permit to construct should be submitted and deemed complete by the district within one year of district rule adoption. Final compliance is required within two years of district rule adoption. This time period should be sufficient to evaluate control options, place purchase orders, install equipment, and perform compliance verification testing.

An additional year for final compliance may be provided for existing engines that will be permanently removed without being replaced by another IC engine. In many cases, such an operation may be nearing the end of its useful life, and it would not be cost-effective to retrofit the engine with controls for only a year of operation. In addition, over the course of several years, the cumulative emissions from the engine to be removed will be less than if this engine were controlled. Although emissions are higher in the first year, lower emissions occur in all subsequent years.

A district adopting a BARCT level of control should consider modifying the compliance schedule for engines that already meet RACT to provide additional time in certain cases to reduce the financial burden on the engine owner or operator. For example, engines complying with a RACT level of control through the use of a catalyst could be subject to an alternative compliance schedule requiring the BARCT level of control when the catalyst is next replaced or 3 years, whichever time period is shorter.

I. Inspection and Monitoring Program

It is the engine owner or operator's responsibility to demonstrate that an engine is operated in continuous compliance with all applicable requirements. Each engine subject to control is required to have an emission control plan describing how the engine will comply. To reduce the paperwork for engine owners or operators, districts can accept an application to construct as meeting the control plan requirements, as long as the application contains the necessary information.

As part of the emission control plan, an inspection and monitoring plan is required. The inspection and monitoring plan describes procedures and actions taken periodically to verify compliance with the rule between required source tests and quarterly NOx monitoring. These procedures and actions should include the monitoring of automatic combustion controls or operational parameters to verify that values are within levels demonstrated by source testing to be associated with compliance.

Examples of parameters that can be monitored in an inspection and monitoring program include exhaust gas concentration, air/fuel ratio (air/fuel ratio control signal voltage for catalyst systems), flow rate of the reducing liquid or gas added to the exhaust, exhaust temperature, inlet manifold temperature, and inlet manifold pressure. For engines that are not required to use continuous monitoring equipment, it is recommended that the inspection and monitoring plan require periodic measurement of exhaust gas concentrations by a portable NOx monitor so that engines can be maintained to produce low emissions on a continuous basis. Where feasible, the portable NOx monitor should be used on a monthly basis. If a portable analyzer is used, it shall be calibrated, maintained and operated in accordance with the manufacturer's instructions and recommendations or with a protocol approved by the Air Pollution Control Officer. The Air Pollution Control Officer shall specify what data is to be collected and the records to be kept as part of the inspection and monitoring plan. Records of the data shall be retained for two years.

These requirements and recommendations are based on Ventura County APCD's Rule Effectiveness Study. One of the conclusions of the study was that most non-compliant engines can come into compliance easily and quickly with minor adjustments. It also appears that compliance can be significantly improved if more frequent inspections are performed. During the time period when the study was conducted, the District's rule required quarterly inspections with portable analyzers and an annual source test. To improve rule effectiveness, the rule was revised to change the frequency of inspections with portable analyzers from quarterly to monthly, while the announced source test frequency was decreased from once a year to once every two years.

In addition, this study also found that engine operators often did not adjust engines to optimal settings except for announced source tests and quarterly inspections. We recommend that, during an initial source test, optimal settings are determined for engine operating parameters affecting emissions. The inspection and monitoring program should require that these optimal settings be frequently checked and maintained. In this fashion, emissions reductions should be maximized.

J. Continuous Monitoring

Continuous monitoring of NOx and O_2 are required for each stationary engine with a brake horsepower rating equal to or greater than 1,000 that is permitted to operate more than 2,000 hours per year. This engine size and operating capacity is found in the SCAQMD's IC engine rule, and was determined to be cost-effective. Continuous emissions monitoring systems (CEMS) may be used to fulfill this requirement. Each district's APCO may consider alternatives, if adequate verification of the systems accuracy and performance is provided. One example of an alternative would be a parametric emissions monitoring system (PEMS) which monitors selected engine parameters and uses the values in calculating emissions concentrations of different pollutants. Continuous monitoring data must be recorded and maintained for at least two years.

In the case of engines covered by Title V permits, the continuous monitoring data should be retained for five years. Refer to the appropriate district's Title V rule(s) to determine if there are any additional monitoring requirements under Title V.

K. Source Testing/Quarterly Monitoring

Source testing of each engine subject to controls would be required every 24 months. Alternatives to the specified ARB and U.S. EPA test methods which are shown to accurately determine the concentration of NOx, VOC, and CO may be used upon the written approval of the Executive Officer of the California Air Resources Board and the Air Pollution Control Officer. In addition, a portable NOx analyzer shall be used to take NOx emission readings to determine compliance with the applicable NOx emission limits during any quarter in which a source test is not performed. A NOx emission reading in excess of the limit shall not be considered a violation, so long as the problem is corrected and a follow-up inspection is conducted within 15 days of the initial inspection. The portable analyzer used to provide the emissions data shall be calibrated, maintained and operated in accordance with manufacturers' specifications and recommendations or with a protocol approved by the Air Pollution Control Officer.

Typically, source testing of many other controlled sources is required every year. However, for IC engines, source testing can be a significant expense, and allowing a longer period between tests would assure that the cost of source testing would not be out of proportion to other operating expenses. Extended source test periods normally are associated with operating out of compliance for longer periods of time and increased emissions. However, the determination requires quarterly monitoring with a portable NOx analyzer and the development and implementation of a detailed inspection and monitoring program, which should provide verification that emission controls are operating properly and the IC engine is in compliance between source tests.

According to one rule effectiveness study, "Phase III Rule Effectiveness Study, VCAPCD Rule 74.9, Stationary Internal Combustion Engines," October 1, 1994, the frequency of non-compliance was greater for unannounced source tests than for annual or announced source tests (5 of 22 compared to 1 in 11). One of the main reasons for this difference is that, based on interviews with the engine owners or operators, in most cases portable emission analyzers are used to tune engines for better emissions performance immediately before announced source tests are performed. Based on this observation, we recommend that districts conduct unannounced source tests so that engines will be maintained to produce low emissions on a continuous basis.

L. Records

Records of the hours of operation and type and quantities of fuel consumed each month would also be required for each engine subject to controls or subject to limits on annual hours of operation which includes emergency standby engines and engines operated less than 200 hours annually. Installation of a nonresettable elapsed operating time meter is required on any spark-ignited IC engine subject to the provisions of the determination. Fuel consumption will be monitored by either installing a nonresettable fuel meter or an acceptable alternative approved by the Air Pollution Control Officer. Owner/operators of stationary spark-ignited IC engines can also propose alternative methods or techniques for estimating fuel consumption for the Air Pollution Control Officer's approval. An example of this latter alternative would be a fuel-use monitoring plan as used in Santa Barbara County. Nonresettable fuel meters installed on stationary spark-ignited internal combustion engines shall be calibrated periodically per the manufacturer's recommendation. For emergency standby engines, all hours of non-emergency and emergency operation shall be recorded along with the fuel usage. These records would be available for inspection at any time, and would be submitted annually to the district.

As previously noted, data is also collected and recorded as part of source testing, quarterly monitoring, continuous monitoring and the inspection and monitoring programs where required. All data taken as a result of continuous monitoring and inspection and monitoring programs shall be maintained for a period of at least two years and made available for inspection by the Air Pollution Control Officer or the Officer's designee. Source test reports shall be submitted to the Air Pollution Control Officer for review. Quarterly NOx readings by portable analyzers shall be reported to the Air Pollution Control Officer or the Officer's designee in a manner specified by the Air Pollution Control Officer.

For engines subject to Title V permits, it is recommended that these records be retained for five years and submitted as part of any Title V reporting requirements as necessary. Refer to the appropriate district's Title V rule(s).

V. COST AND COST-EFFECTIVENESS

This chapter reviews the costs and cost effectiveness associated with the installation of emission controls on stationary spark-ignited engines. The cost estimates and cost effectiveness numbers provided here are general in nature and apply to generic engines without consideration of the engine application and local or site-specific conditions or situations which could have a significant cost impact. In developing rules, districts are encouraged to perform their own cost analysis and to obtain contemporary cost data from emission control manufacturers, contractors, industry sources and associations, government agencies, and owner/operators of stationary engines which have been retrofitted with emission controls. This approach will ensure that the cost analysis has a greater degree of accuracy.

The cost of NOx controls for reciprocating IC engines can vary widely depending on the individual site, size of engine, fuel type, type of engine, operational characteristics of the engine, and other parameters. For engines requiring the installation or replacement of major pieces of equipment, such as catalysts, engine heads, and turbochargers, the largest expense is the capital cost of controls. The replacement cost for catalysts can also be a major expense.

When an engine is controlled, greater care must be taken to assure that it is properly maintained, and thus maintenance costs may increase.

Fuel consumption may be increased by several percent for some of the controls. However, for some uncontrolled engines, modifications that lean the air/fuel ratio may decrease fuel consumption.

Depending on the existing equipment and requirements, other costs associated with achieving the determination's requirements may include the purchase and installation of hour and fuel meters; purchase, installation, and operation of emissions monitors; source testing; permit fees; and labor and equipment costs associated with the inspection and monitoring program.

A. Costs for RACT/BARCT

The cost estimates in Table V-1 list the capital (including installation) cost for several of the most commonly used control techniques and technologies. Control techniques such as air/fuel ratio changes or ignition system improvements are not listed in Table V-1. These techniques are usually part of a collection of techniques such as a "low-emission combustion" controls and therefore are included in those cost estimates already shown in Table V-1. However, the benefits and estimated costs of each separate technique is listed in Appendix B. The estimated costs shown in Table V-1 are considered general costs because of the wide variation in engine configuration and application used by the various industries in California as well as the variation in engine specifications within a series of engines produced by a manufacturer.

Table V-1
Cost Estimates for ICE Control Techniques and Technologies

Horsepower Range	Ign. Timing Retarding	Pre-Stratified Charge	NSCR[1] W/O AFRC	AFRC[2]	SCR[3]	Low-Emission Combustion Retrofit	Electrification[4]
50-150	$300	$10,000	$13,500	$4,200	$45,000	$14,000	$28,000
151-300	$450	$23,000	$18,500	$5,000	$45,000	$24,000	$49,000
301-500	$500	$30,000	$20,500	$5,000	$60,000	$42,000	$79,000
501-1,000	$800	$36,000	$30,500	$5,300	$149,000	$63,000	$177,000
1001-1,500	$900	$42,000		$5,300	$185,000	$40,000-256,000	
1501-2,000	$1,000	$47,000		$6,500		$40,000-256,000	
2,001-3,000	$1,400					$40,000-256,000	

1. NSCR is an abbreviation for Nonselective Catalytic Reduction
2. AFRC is an abbreviation for air/fuel ratio controller
3. SCR is an abbreviation for Selective Catalytic Reduction. The costs are based on Urea injection, with parametric emissions monitoring system, and catalyst sized for 96 percent NOx conversion for lean burn engines.
4. The costs for electrification assume the units will be located relatively close to a power grid. If this is not the case, a cost of $5,000 to $10,000 may be incurred to have the local utility company install the appropriate power outlet for the motor to the local utility grid.

The cost estimates shown in Table V-1 are a mixture of quotes and extrapolations of cost from information provided by industry sources, associations, local governments, and the U. S. EPA. It also includes an estimated cost for replacing engines in various horsepower ranges with an electric motor. Electrification may be a consideration as an alternative for internal combustion engines from 50 to 500 horsepower. Beyond that range, modification and installation costs may become so extensive that this approach may not be cost effective. The costs for electrification assume the units will be located relatively close to a power grid. If this is not the case, a cost of $5,000 to $10,000 may be incurred to have the local utility company install the appropriate power outlet for the motor to the local utility grid. In some utility districts, the cost for connecting to the power grid may be waived or refunded if the monthly energy usage matches or approach the cost to connect to the grid.

B. Cost-Effectiveness

Table V-2 lists the estimated cost-effectiveness for the control techniques and technology listed in Table V-1. It should be noted that these costs are estimates and may vary according to site-specific parameters, situations, and conditions. For purposes of this cost analysis, it was assumed that the engines operated at rated load for 2,000 hours per year. The costs for the different control technologies include the capital and installation costs. In the case of ignition timing retard, it was assumed that the ignition timing was retarded during the engine's normal

Table V-2
Cost-Effectiveness Estimates for ICE Control Techniques and Technologies[5]

Control	Horse Power Range	Capital Cost ($)	Installation Cost($)	O & M Cost($/year)	Annualized Cost ($/year)	Cost-Effectiveness ($/ton of NOx Reduced)
Ignition Timing Retard (@ 15% reduction)[3]						
	50 - 150	N/A	N/A	4,700	4,700	7,300
	151 - 300	N/A	N/A	3,400	3,400	2,100
	301 - 500	N/A	N/A	2,900	2,900	1,100
	501 - 1000	N/A	N/A	3,200	3,200	600
	1001 - 1700	N/A	N/A	3,300	3,300	100
Prestratified Charge (@ 80% reduction)[2,3]						
	50 - 150	10,000	N/A	1,000	2,700	800
	151 - 300	23,000	N/A	1,500	5,300	700
	301 - 500	30,000	N/A	2,000	6,900	500
	501 - 1000	36,000	N/A	2,500	8,400	300
	1001 - 1700	47,000	N/A	3,000	10,700	200
Nonselective Catalytic Reduction w/o AFRC (@ 96% reduction)[3]						
	50 - 150	11,000	2,500	6,000	8,200	2,100
	151 - 300	16,000	2,500	6,700	9,000	900
	301 - 500	18,000	2,500	7,700	10,000	600
	501 - 1000	28,000	2,500	10,200	13,000	400
	2500	44,000	3,000	17,800	18,000	300
Selective Catalytic Reduction for Lean Burn(@ 96% reduction)[1,3]						
	50 - 150	32,000	13,000	20,000	27,000	7,300
	151 - 300	32,000	13,000	26,000	33,000	4,400
	301 - 500	43,000	17,000	35,000	36,000	2,900
	501 - 1000	116,000	33,000	78,000	78,000	2,900
	1001 - 1500	132,000	53,000	117,000	148,000	2,400
Low-Emission Combustion Retrofit (@ 80% reduction)[2,3,4]						
	50 - 150	14,000	N/A	N/A	2,300	1,100
	150 - 300	24,000	N/A	N/A	3,900	1,000
	300 – 500	42,000	N/A	N/A	6,900	500
	500 - 1000	63,000	N/A	N/A	10,250	400
	1000 – 1500	40,000-256,000	N/A	N/A	6,500-41,700	100-900
Electrification[3]						
	50 - 150	14,000	13,600	unknown	4,600	1,100
	150 - 300	24,000	25,300	unknown	7,700	900
	300 - 500	40,000	38,800	unknown	12,900	900
	500 - 1000	90,000	87,300	unknown	29,000	1,100

1 The cost for the SCR is based on Urea injection, with parametric emissions monitoring system, and catalyst sized for 96 percent NOx conversion.
2 The cost for fuel is not included in any calculation except for ignition timing retard.
3 The annualized cost do not include local costs such as permit fees, or cost for compliance assurance inspections or source testing.
4 Not Applicable (N/A). The costs for a "low-emission combustion" engine or retrofit kit assume engine replacement or kit installation during the normal rebuild or replacement cycle of the existing engine.
5 The cost effectiveness analysis is performed assuming that the engines are run at rated power (100% load) for 2,000 hours annually. This is equivalent to a capacity factor of approximately 0.23.

tune-up. Consequently, there are no installation costs associated with this technique. This table also includes the expenses associated with additional maintenance and parts for the emission control, and the cost of additional or reduced fuel usage as a result of the control technology. In some applications, stationary engines are used to run compressors or generators. If the compressor or generator and the engine are an integral unit, then any additional costs incurred as a result of this integration should be included in the control equipment cost. Those additional costs are not reflected in the table.

For each control technique or technology, the cost effectiveness is based on an estimated percent of emission reduction of NOx from an uncontrolled engine. Some technologies, such as NSCR, can be used in stages to reduce emissions by having the exhaust gas flow through a series of catalyst modules. In the case of ignition timing retard, fuel usage may increase by as much as 5 percent. The cost for the increased fuel use is included in the annualized cost shown in Table V-2 under that particular option. None of the other technologies are expected to increase fuel consumption drastically enough to contribute significantly to a cost increase. In fact, prestratified charge and low-emission combustion technologies are expected to decrease fuel consumption because they result in a leaner burning engine. Likewise, operational and maintenance costs with the ignition timing retarded engine and the prestratified charged engine is not expected to increase significantly. The maintenance cost for the SCR system is associated with the use of urea and the maintenance of the SCR components, not necessarily with the engine directly.

Some technologies, such as "low-emission combustion", have nominal emissions limits specified by the manufacturer. The costs for a low-emission combustion engine or retrofit kit assume engine replacement or kit installation during the normal rebuild or replacement cycle of the existing engine. By exchanging the older engine or installing a low-emission combustion kit during an engine's regularly scheduled rebuild or replacement time allows a majority of the installation cost to be treated as a normal maintenance cost and not a cost directly incurred to achieve emission reduction. Because of the wide range of low-emission combustion configurations for engines above 1,000 horsepower, those costs are listed as a range. Engines larger than 1,000 horsepower should be evaluated on a case-by-case basis.

The cost-effectiveness estimates were derived by first estimating annual costs for each control. The annualized cash flow method was applied to the pre-tax capital and installation costs using a nominal interest rate (including inflation) of 10 percent over a 10 year life. To this annualized cost were added the estimated additional annual fuel (where applicable) cost, plus operation and maintenance cost attributable to the control method. This sum yields the total annual cost which is listed as the "Annualized Cost" in Table V-2. It is assumed that the engines operate 2,000 hours annually at full load. The cost effectiveness for the emissions controls on engines operating fewer hours per year and/or at lower loads will be higher.

Secondly, NOx reductions were estimated. The process used to determine reductions included selecting typical NOx emission rates from uncontrolled engines in each size category listed in Table V-2. Next, we estimated annual NOx emissions, and annual NOx emission reductions for each control method based on the percent NOx reductions listed for each control type in Table V-2. The cost-effectiveness is then calculated by dividing the "Annualized Cost" by the annual emission reductions. It should be pointed out that some of these control methods could result in reductions of other pollutants and/or an increase in fuel economy, which would be additional benefits.

It should be noted that the cost-effectiveness for prestratified charge (PSC) versus NSCR is very competitive in terms of pollutant reduced per dollar spent. In fact, if the cost of an air to fuel ratio controller is included with the cost of the NSCR, it becomes less cost-effective than the PSC. Also, the operation and maintenance cost for NSCR includes catalyst replacement after five years of operation. For lean burn engines, SCR is a very effective NOx reduction technology, but it is also relatively expensive for lean-burn engines when compared to a low-emission combustion retrofit which is more cost effective.

As Table V-2 shows, cost-effectiveness for the selected technologies is equal to or less than $2,500 per ton of NOx reduced, with the exception of Ignition Timing Retard (ITR) for engines with horsepower rating below 150, and SCR on engines with horsepower ratings below 1000. The higher cost-effectiveness for the ITR engines below 150 horsepower is due to the expected increase in fuel use. However, the cost-effectiveness for all of the controls listed are well below the $24,000 per ton bench mark used in this document and by some of the air quality districts. The installed and annualized costs for SCR are the highest in Table V-2. As mentioned previously, each engine site has to be considered on an individual basis along with the characteristics of each control type when considering emission reduction technologies.

Electrification cost-effectiveness is also estimated in Table V-2 for a range of engines up to 3000 horsepower in size. Below 500 horsepower, the installed costs associated with electrification are less than the installed cost for an equivalent internal combustion engine. Between 500 and 1000 horsepower, installed costs for electrification are comparable with that of an internal combustion engine. For engines larger than 1000 horsepower, electrification becomes very expensive with the primary advantage being that NOx emissions are reduced 100 percent although emissions from electrical power generating power plants will increase slightly.

C. Other Costs

The previous tables, for the most part, have covered the capital, operating, and maintenance costs for controls. Other expenses may also be encountered to comply with the determination. In the case of hour meters and fuel meters, many engines already have such measuring devices, so there would be no additional cost. For engines using SCR, often the cost of a continuous NOx monitor is included in the cost of controls.

This determination requires the use of an hour meter on exempt emergency standby engines operating fewer than 100 hours per year. In addition, many districts will likely require the use of fuel and hour meters for recordkeeping and compliance verification purposes. For completeness, the following information on these costs is provided as follows. Hour meters typically cost between $30 and $80 each, while a fuel meter with an accuracy of plus or minus three percent can range in cost from about $340 up to $4,500 depending on the manufacturer, fuel type, and fuel flow rate. A meter for gaseous fuel, such as natural gas, is more expensive than one for liquid fuels because gaseous fuel meters must compensate for pressure and temperature.

The determination also requires the installation of an emissions monitoring system for engines rated 1,000 brake horsepower and greater and permitted to operate more than 2,000 hours per year. Costs of such a system vary depending on whether continuous emissions monitors are used or parametric monitoring is employed. The capital and installation cost of a continuous emission monitor ranges from $25,000 to $100,000, and a parametric system ranges from $25,000 to $40,000. The annual operating and maintenance costs (per engine) are estimated to be $7,500 for a continuous emission monitoring system, and $2,000 for a parametric emissions monitoring system. Costs are also associated with periodic source testing which is required to determine an engine's compliance with the emission limits. The cost of a source test is about $3,000 per engine using a reference method such as ARB Method 100. Costs are less if multiple engines are tested at the same time.

As part of the inspection and maintenance requirements, it is recommended that exhaust emissions be periodically checked with a hand-held portable analyzer. The cost of a hand-held portable analyzer is about $10,000 to $15,000. Many engine operators who perform their own maintenance and maintain several engines already use portable analyzers. Smaller operators generally contract out engine maintenance, and nearly all maintenance contractors already have analyzers. Thus, in most cases, requiring periodic checks with an analyzer is not expected to increase costs significantly.

D. Incremental Costs and Cost-Effectiveness

New requirements for the adoption of rules and regulations were passed by the State Legislature in 1995. These requirements, found in Health and Safety Code Section 40920.6, apply to districts when adopting BARCT rules or feasible measures. Specifically, when adopting such rules, districts must perform an incremental cost-effectiveness analysis among the various control options. Incremental cost-effectiveness data represent the added cost to achieve an incremental emission reduction between two control options. Districts are allowed to consider incremental cost-effectiveness in the rule adoption process.

When performing incremental cost-effectiveness analyses, in some cases an uncontrolled baseline may be appropriate. Table V-3 summarizes an incremental cost-effectiveness comparison for an uncontrolled baseline. For example, the costs for controlling an uncontrolled engine with the application of prestratified charge controls is estimated, along with the costs for replacing the engine with an electric motor. Emission reductions for application of these two

Table V-3 Incremental Cost-Effectiveness Estimates for ICE Control Techniques and Technologies				
Engine Type	**Control Comparison**	**Horsepower**	**Incremental NO_X Reduction (tons/year)**	**Incremental NO_X Cost-Effectiveness ($/ton of NO_X Removed)**
Rich-Burn				
	From Pre-Stratified Charge to NSCR (96%)	50-150	0.7	7,700
		150-300	1.7	2,200
		300-500	2.9	1,100
		500-1000	9.5	500
	From Pre-Stratified Charge to Electrification	50-150	0.9	2,200
		150-300	2.2	1,100
		300-500	3.6	1,700
		500-1000	7.1	2,900
	From NSCR to Electrification	50-150	0.2	(21,200)
		150-300	0.4	(3,000)
		300-500	0.7	4,000
		500-1000	1.6	10,100
Lean Burn				
	From Low-Emission Combustion to SCR (96%)	50-150	0.4	58,900
		150-300	0.8	35,100
		300-500	3.3	8,800
		500-1000	6.6	10,300
	From Low-Emission Combustion to Electrification	50-150	0.9	2,700
		150-300	2.2	1,800
		300-500	3.6	1,700
		500-1000	3.6	2,400

different control methods to an uncontrolled engine are also estimated. The incremental cost-effectiveness is determined by dividing the difference in costs by the difference in emission reductions. The Table V-3 estimates were developed from the cost effectiveness analysis summarized in Tables V-2. For rich-burn engines, it was assumed that the prestratified charge technology would achieve an 80 percent NOx reduction and the NSCR control technology would achieve a NOx reduction performance of 96 percent control. Both of these technologies were compared against electrification as well as each other. The emissions reduction associated with electrification was assumed to be 100 percent. For lean-burn engines, incremental cost-effectiveness analyses compared low-emission combustion to electrification and SCR technologies. The results are included in Table V-3. The numbers in parentheses shown in Table V-3 indicates a cost saving per incremental ton of NOx reduced for the latter technology when compared to the former technology.

Districts that adopt a BARCT level of control for IC engines may have already required a RACT level of control for these engines. Table V-4 summarizes data from Ventura County APCD. Its provides incremental cost-effectiveness estimates for the case where a RACT level of control has already been installed (i.e., baseline is RACT such as prestratified charge or NSCR designed to 90 percent control). In addition the control equipment is either modified or replaced to meet BARCT limits (i.e., NSCR with 96 percent control). It should be noted that Ventura APCD's analysis was performed for lean-burn engines reducing NOx emissions to 45 ppm or achieving reductions of 94 percent as opposed to our BARCT limits of 65 ppm or 90 percent. The base NOx emission limits for this analysis are identical to our RACT NOx limits.

Incremental cost-effectiveness values should be used to determine if the added cost for a more effective control option is reasonable when compared to the additional emission reductions that would be achieved by the more effective control option. Historically, when determining cost-effectiveness, districts have estimated the costs and emission reductions associated with controlling uncontrolled sources. This latter method is sometimes called "absolute" cost-effectiveness. Incremental cost-effectiveness should not be compared directly to a cost-effectiveness threshold that was developed for absolute cost-effectiveness analysis. Incremental cost-effectiveness calculations, by design, yield values that can be significantly greater than the values from absolute cost-effectiveness calculations. Direct comparisons may make the cost-effectiveness of an economic and effective alternative seems exceedingly expensive.

Table V-4
Incremental Cost and Cost-Effectiveness Summary for Application of BARCT to RACT Controlled Engines[1]

Engine/ Control	Size Range (HP)	Number of Engines	Reduction Needed (%)	Emissions Reduction (tons/yr)[2]	Capital Costs ($)	O&M Costs ($/yr)	Cost-Effectiveness ($/ton)[3]	($/ton, adjusted to 1999 dollars)
Rich-burn								
From NSCR (90%/50 ppm) to improved NSCR (96%/25 ppm)								
	100-200	6	36	2.93	9,185	1,888	9,300	9,740
	225	1	22	0.37	9,185	1,888	8,200	8,590
	412	2	25	0.79	18,335	1,673	10,000	10,470
	625	1	19	0.79	18,260	2,399	6,000	6,280
	700-800	3	50	6.27	18,260	2,399	2,300	2,410
	1250	3	34	5.85	18,260	2,399	3,300	3,460
From PSC (90%/50 ppm) to NSCR (96%/25 ppm)								
	300	3	50	7.84	10,600	1,673	1,300	1,360
	330	3	53	0.62	10,600	1,673	17,000[4]	17,800
Lean-burn								
From SCR (80%/125 ppm) to improved SCR (94%/45 ppm)								
	660	2	62	14.81	105,000-346,500	15,000	3,800-7,900	3,980-8,270
From Low-Emission Combustion (80%/125 ppm) to added SCR (94%/45 ppm)								
	1108	8	29	39.38	105,000-346,000	15,000	6,300-13,000	6,600-13,610

1. Reference: Ventura County APCD Staff Report for Rule 74.9, December 1993
2. Based on actual emissions rate
3. Capital recovery factor of .125 used (approximately 9 percent interest for 15 years)
4. Operator proposed electrification for these engines

VI. IMPACTS

A. Air Quality

NOx is a precursor to ozone, and State and Federal ozone ambient air quality standards are violated throughout many parts of California. In addition, although most NOx is emitted in the form of nitric oxide (NO), on most days NO will rapidly oxidize to form nitrogen dioxide (NO_2). There are State and federal ambient air quality standards for NO_2. NOx is also a precursor to particulate nitrate, which can contribute to violations of PM10 (particulate matter less than 10 micrometers in aerodynamic diameter) and PM2.5 ambient air quality standards. Violations of PM10 standards are even more widespread than ozone violations in California. Reductions in NOx emissions will reduce ozone, nitrogen dioxide, and PM10 and PM2.5 concentrations, and reduce the number of violations of State and Federal ambient air quality standards for these four pollutants.

Table VI-1 lists emission reduction estimates by district for NOx emissions from stationary IC engines. In order to develop NO_x emissions reductions estimates for this determination, we used the 1996 Air Resources Board's point source emissions inventory. We first identified districts that do not currently have IC engine rules and are designated as nonattainment for the State ozone standard. We also identified which districts are required to adopt RACT rules, and which districts are required to adopt BARCT rules.

The Table VI-1 emission reduction estimates were calculated assuming no reduction would come from engines emitting one ton or less of NOx per year. Engines with emissions of one ton or less are often standby emergency generators, which would be exempt from control requirements. In addition, no reductions were assumed for engines that are already controlled.

In order to determine emissions reduction percentages, we identified control technologies likely to be used for compliance with the guidelines. For spark-ignited engines in districts required to adopt RACT emissions limits, leaning of the air-fuel mixture or retrofitting of low-emission combustion kits are the control technologies expected to be used. These technologies are expected to achieve NO_x reductions of approximately 80 percent. For waste gas fueled engines, the BARCT limits will be met by using prestratified charge systems or clean burn retrofits. These technologies are expected to achieve NO_x reductions of approximately 80 percent. For engines burning fuels other then waste gas, the BARCT emissions limits are expected to be met using NSCR, clean burn retrofit, or SCR. These technologies are expected to achieve NO_x reductions of at least 90 percent. We looked at the number of engines in each district that were spark-ignited, or used waste gas for fuel and applied these NO_x emissions reduction estimates to each engine to determine NO_x emissions reductions. Since in some respects this inventory may underestimate actual emissions (see Chapter I), the actual emission reductions may be greater than the estimates in Table VI-1. However, to the extent that engines have already been controlled but are reported in the inventory as being uncontrolled, the Table VI-1 estimates may be higher than actual emissions reductions. Total statewide NO_x emissions reductions from districts without rules are 601 tons per year, or about 2.5 percent of NO_x emissions from SI engines.

Table VI-1

Estimated NO_x Emissions Reductions for Stationary Source Spark Ignited (SI) Engines from Districts without IC Engine Rules

Emissions in Tons per Year

District	Ozone Classification	1996 Inventory	SI Engine Emissions Reductions
Butte County AQMD	Moderate	14	6
Feather River AQMD	Moderate	361	289
Glenn County APCD	Moderate	325	248
Monterey Bay Unified APCD	Moderate	76	58
Totals		**776**	**601**

Source: Air Resources Board 1996 Point Source Inventory

Potential emissions reductions for some of the larger districts with IC engine rules are estimated in Table VI-2. Engines in districts that already have IC engine rules may already be controlled. Therefore, it may not be cost effective for these districts to require these lower limits. To the extent that requiring lower emissions limits is not cost effective, or if controlled engines are already emitting at levels below those required by district rules, the emissions reductions in Table VI-2 are overestimated.

Table VI-2

Estimated NO_x Emissions Reductions for Stationary Source Spark Ignited (SI) Engines from Larger Districts with IC Engine Rules[1,2]

Emissions in Tons per Year

District	Ozone Classification	1996 Inventory	SI Emissions Reductions
San Diego	Serious	238	155
San Joaquin Valley	Severe	4,882	2,104
Santa Barbara	Moderate	985	433
South Coast[3,4]	Extreme	4,259	1,375
Totals		**10,364**	**4,067**

Source: Air Resources Board 1996 Point Source Inventory

[1] Includes only point sources.
[2] Assumes engines emit at levels required in district rules.
[3] Assumes 87 percent of SI engines are rich-burn per 1990 SCAQMD IC engine staff report.
[4] Assumes 50 percent of rich-burn SI engines are > 500 hp, 50 percent are < 500 hp, as different standards apply for each category.

Totaling tables VI-1 and VI-2 gives potential NO_x reductions of approximately 4,700 tons per year, or approximately 20 percent of statewide NO_x emissions from SI engines.

B. Economic Impacts

The economic impacts from meeting the requirements of this determination will be a function of the type of engine and controls used, and the financial health of the engine owner or operator. The costs and cost effectiveness are discussed in detail in Chapter V.

An NSCR catalyst is the control method expected to be used on most rich-burn engines. The total (annualized capital plus operating and maintenance) cost of an NSCR catalyst will range from approximately $8,200 to $18,000 depending on the size of the engine. This annualized cost is based on a ten-year life for the catalyst. The required source testing would add to this total. These costs are detailed in Table V-2. In addition, source testing of an engine's emissions is required periodically, and this will cost about $3,000 for a single engine, and less on a unit basis if multiple engines are tested during the same period.

The costs of retrofitting a lean-burn engine to meet the determination's NOx limits will generally be greater than for a rich-burn engine. Retrofit costs can vary significantly, with lower costs associated with the use of an economical clean burn retrofit kit, and higher costs if a turbocharger or other expensive equipment must be replaced or added, or if SCR controls are used.

For larger engines operating a substantial number of hours per year, NOx and oxygen concentrations must be monitored continuously. In addition, for other engines using SCR, a continuous NOx monitor is often included as part of the controls package. The cost of continuous monitoring can be significant. The purchase and installation costs of a stand-alone NOx monitor and data acquisition and reporting system can range from $25,000 to $100,000. As an alternative to monitoring NOx directly, districts may find parametric monitoring to be a reasonable alternative. In parametric monitoring, several engine ambient and operational parameters are monitored, and these parameters are used to calculate NOx emissions. The monitoring of engine parameters can be less expensive than monitoring NOx directly. The capital cost for a parametric system ranges from $25,000 to $40,000. The annual operating and maintenance costs (per engine) are estimated to be $7,500 for a continuous emission monitoring system, and $2,000 for a parametric emission monitoring system.

Table VI-3
Cost Estimates for IC Engine Monitoring

Monitoring Device	Capital Costs	O&M Costs (per engine)
Continuous Emissions Monitoring	$25,000-$100,000	$7,500
Parametric Emissions Monitoring	$25,000-$40,000	$2,000

C. Catalysts

Both NSCR and SCR catalysts contain heavy metals and other toxic substances that may create environmental problems if they are not disposed of properly. In the case of NSCR catalysts, it is usually cost-effective to reclaim and recycle the heavy metals from spent catalysts. For all catalysts, the cost of proper disposal is relatively minor, and catalyst vendors generally will agree to dispose of their own used catalysts at no charge.

In the case of SCR, ammonia or urea is injected into the exhaust gas to reduce NOx, and some of the ammonia is released into the atmosphere unreacted. Ammonia is a toxic compound (but not a TAC) at high concentrations and can also be a precursor to the formation of particulate matter. At lower concentrations, ammonia can cause health effects and can be a nuisance due to odor. Therefore, many districts have adopted rules or specified permit conditions, which limit the ammonia concentration in the exhaust vented to the atmosphere. These limits vary from a few ppmv to about 50 ppmv. Two districts have engine rules which set an ammonia emission limit of 20 ppmv from any emissions control device.

There are also safety concerns associated with accidental spills of ammonia. Not only is ammonia a toxic compound, but it is also a fire hazard at extremely high concentrations. Constructing and operating the ammonia system in conformance with existing safety and fire regulations can mitigate these concerns. Another way to minimize the safety concerns with ammonia is to replace it with urea. Urea, which has been used extensively in Europe, is nontoxic, non-odorous, and nonflammable. It dissolves easily in water and has been used as a fertilizer and an additive in animal feed and cosmetics.

D. Methanol

Methanol is a toxic compound that can cause serious health effects if ingested, breathed, or absorbed through the skin. In addition, combustion of methanol in IC engines can result in elevated formaldehyde exhaust emissions. The ARB has identified formaldehyde as a toxic air contaminant. Careful handling of methanol and conformance to existing health and industrial standards should minimize any safety hazards associated with methanol. Formaldehyde emissions can be minimized by assuring that the IC engine does not operate overly rich, and by the use of an oxidation catalyst. Methanol has been used as a fuel for cars and buses for a number of years with little or no adverse health impacts noted.

E. Energy Impacts

Controls used to meet the NOx limits in this determination are not expected to have a significant impact on energy usage. In many instances, controls may increase fuel consumption by a few percent, but there may be a net fuel savings in other instances. For example, if a NOx limit is met by replacing a rich-burn engine with a new, low NOx lean-burn engine, fuel consumption will decrease by about five to eight percent.

F. PM Impacts

Controls used to meet the NOx limits in this determination may also increase PM emissions. Emissions of particulate matter are generally very low for a properly operating spark-ignited engine. Particulate matter emissions from spark-ignited engines can be minimized by assuring that the air/fuel ratio is not overly rich and the fuel is low in sulfur content. Commercial natural gas, commercial LPG, and California cleaner burning gasoline are all extremely low in sulfur. For fuels high in sulfur such as waste gases, scrubbing the sulfur from the fuel before it is introduced into the engine can minimize emissions of particulate matter.

VII. OTHER ISSUES

This chapter addresses miscellaneous issues concerning Federal, State, and local regulation of stationary IC engines, nonroad engines, and portable engines as well as the control of toxic emissions from these engines.

A. Effect of District, ARB, and U.S. EPA Regulations

The districts in California have primary responsibility for control of air pollution from stationary sources. Thus, districts have the authority to adopt rules and regulations controlling emissions from IC engines that are stationary sources. The ARB and U.S. EPA also have authority to control emissions from certain engines, including motor vehicle engines, nonroad (off-road) engines, and other types of engines. The California Health and Safety Code authorizes the ARB to adopt standards and regulations for motor vehicles and for certain off-road or nonvehicle engine categories, including farm equipment and construction equipment. Under the federal Clean Air Act, the U.S. EPA has authority to control emissions from stationary sources and from mobile sources, including nonroad engines. The U.S. EPA may authorize California to enforce requirements for certain motor vehicle engines and nonroad engines if standards are at least as protective as applicable federal standards. U.S. EPA has granted such waivers to California for a number of engine categories.

1. ARB IC Engine Regulations

Two major provisions in State law authorize the ARB to control emissions from nonvehicular IC engines. The first of these, Section 43013 of the Health and Safety Code, grants the ARB authority to adopt standards and regulations for a wide variety of off-road or nonvehicle engines. These include off-highway motorcycles, off-highway vehicles, construction equipment, farm equipment, utility engines, locomotives, and marine vessels. Under Section 43013, the ARB has adopted regulations for several engine categories, including small off-road engines, large off-road spark ignition engines, and portable engines. Some of these engines could be used in applications where the engines are considered to be stationary sources. In such situations, the ARB staff has concluded that the district holds jurisdiction, and the engine must comply with district rules and regulations.

The second major provision in State law regarding ARB authority to control emissions from nonvehicular IC engines can be found in Health and Safety Code sections 41750 through 41755. These sections require the ARB to develop uniform statewide regulations for the registration and control of emissions from portable engines. ARB adopted regulations on March 27, 1997, which became effective September 17, 1997. It should be noted that this RACT/BARCT determination for stationary IC engines exempts all portable engines if they are registered either with a local district or under the statewide registration program described in the following paragraph.

The Statewide Portable Equipment Registration Program establishes a uniform program for portable engines and portable engine-driven equipment units. Once registered, engines and equipment units may operate throughout California without the need to obtain individual permits from local air districts. Districts are pre-empted from permitting, registering, or regulating portable engines and portable equipment units registered with the ARB. However, local districts are responsible for enforcing the Program. The Statewide Portable Equipment Registration Program Regulations can be found in sections 2450 through 2466, title 13, California Code of Regulations.

The California Clean Air Act (CCAA) requires districts that are unable to achieve five percent annual emission reductions to demonstrate to the ARB's satisfaction that it has included every feasible measure in its clean air plan and an expeditious adoption schedule for these measures. ARB interprets the adoption of every feasible measure to mean, at a minimum, that districts consider regulations that have been successfully implemented elsewhere. Districts should also consider going beyond what has already been accomplished by evaluating new technologies and innovative approaches that might offer potential emission reductions. In addition, districts should consider not only technological factors, but social, environmental, and energy factors within the district, as well as cost-effectiveness and the district's ability to realistically adopt, implement, and enforce measures. The use of RACT/BARCT standards on existing stationary sources is one of the feasible measures required by the CCAA. Furthermore, districts may require the repowering or replacement of IC engines with cleaner IC engines or electric motors under every feasible measure. In these situations, it is recommended that districts consider electrification whenever it is feasible in order to maximize emission reductions.

2. U.S. EPA IC Engine Regulations

A district's ability to control emissions from stationary IC engines may be affected by federal regulations for nonroad engines. Effective July 18, 1994, the U.S. EPA promulgated 40 CFR Part 89-- Control of Emissions from New and In-use Nonroad Engines. In 40 CFR 89.2, U.S. EPA adopted a definition of nonroad engine that distinguishes between stationary and nonroad sources for purposes of federal regulation. Under the federal definition, nonroad engines are IC engines that are in or on equipment that is self-propelled or are portable. However, if a portable IC engine remains at one location for more than 12 months (or, for a seasonal source, the duration of the season), it is not a nonroad engine and may be considered a stationary source. On the other hand, if the engine moves within 12 months (or, for a seasonal source, during the season), even if the move is within the boundaries of a single site, the engine may be considered a nonroad engine. Examples of nonroad engine applications are bulldozers, lawnmowers, or agricultural engines that are on trailers. 40 CFR Part 89 should be consulted for a more detailed explanation of the federal definition of nonroad engine.

Under the federal Clean Air Act and U.S. EPA definitions, a district may have adopted definitions that differ from U.S. EPA definitions and therefore, in certain circumstances, may consider a nonroad engine to be a stationary source in certain circumstances.

Under the federal Clean Air Act Amendments of 1990, the U.S. EPA is authorized to regulate newly manufactured nonroad engines. In general, the CAA amendments expressly prohibit states (including districts) from adopting emissions standards or other control technology requirements for nonroad engines [CAA, section 209(e)]. However, Congress provided in the CAA that California, upon receiving authorization from the U.S. EPA, could adopt and enforce standards and regulations for most categories of nonroad engines if the requirements are at least as protective as the applicable federal standards. (However, all states, including California, are preempted from setting emission standards for new nonroad engines that are less than 175 horsepower and are used in farm or construction vehicles or equipment).

In accordance with U.S. EPA preemption provisions, this RACT/BARCT determination exempts from rule requirements engines that meet the U.S. EPA definition for new nonroad engines that are less than 175 horsepower and used in construction or farm equipment or vehicles.

Owners or operators of IC engines may also be subject to Title V of the Federal Clean Air Act. Title V requires California air districts to develop and implement local operating permit programs for major stationary sources. TitleV applicability may vary depending on a source's location and the type and potential amount of air pollutants emitted. In the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), the major source applicability thresholds are currently 50 tons per year (TPY) for NO_X and VOC (If the district is reclassified from serious to severe nonattainment with respect to national ambient air quality standards, the major source thresholds for NO_X and VOC will change from 50 TPY to 25 TPY). For PM_{10} and SO_X the major source threshold in the SJVAPCD is 70 TPY.

B. Emissions of Hazardous Air Pollutants/Toxic Air Contaminants

1. Hazardous Air Pollutants/Toxic Air Contaminants Emitted

Fuels used in stationary IC engines and exhaust gases from these engines contain toxic substances. These substances are labeled hazardous air pollutants (HAPs) by the U.S. EPA and toxic air contaminants (TACs) by the ARB. A TAC is defined in Health and Safety Code as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health. In April 1993, the ARB designated all HAPs listed in subsection (b) of Section 112 of the federal CAA as TACs. Toxic substances differ from criteria pollutants such as NOx, CO, SOx, and particulate matter because of the large number of substances that are potentially toxic and identified threshold or safe levels for many toxics. In addition, toxic substances tend to be emitted in much smaller amounts than criteria pollutants, but their toxicity tends to be much greater.

Emissions of toxic substances from the exhaust of natural gas-fired engines are the result of incomplete combustion. These toxic substances include: formaldehyde, polycyclic aromatic hydrocarbons (PAHs), acetaldehyde, acrolein, benzene, ethyl benzene, toluene, and xylenes. Recently, two-stroke and four-stroke, lean-burn engines were tested as part of U.S. EPA's Industrial Combustion Coordinated Rulemaking (ICCR) process. For the four-stroke SI engine, formaldehyde was detected in all of the test runs while acrolein was found in less than half and at levels usually a factor of 1,000 smaller than the formaldehyde. Similarly, formaldehyde was found in all of the test runs on the two-stroke SI engine with significantly smaller amounts of toluene, benzene, and a few PAHs. The rest of the compounds were not measured at detectable levels.

HAP emissions are also regulated by Title V. For sources HAPs in all districts, the major source threshold is 10 TPY of a single HAP or 25 TPY of a combination of HAPs.

2. U.S. EPA Requirements

The source category list published by U.S. EPA under CAA section 112(b) requires the MACT standard for stationary reciprocating IC engines to be promulgated by November 15, 2000. Once U.S. EPA promulgates a MACT standard, it becomes an air toxic control measure (ATCM) under state law, unless an ATCM for the source category has already been adopted. The U.S. EPA developed the ICCR process to develop MACT standards for combustion sources. This process, started in 1996, gathered representatives of industry, environmental groups, and state and local regulatory agencies together to develop MACT standards for industrial and commercial heaters, boilers, and steam generators, gas turbines, and IC engines. U.S. EPA is planning on releasing a MACT standard for reciprocating IC engines soon.

3. State and District Requirements

The State and districts have had, for a number of decades, the authority to control air toxics that pose a health hazard. However, the formal framework for setting emission limits for air toxics was not in place until enactment of the Toxic Air Contaminant Identification and Control Act (AB 1807) in 1983. In 1987, passage of the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588) expanded the role of the ARB and districts by requiring a statewide air toxics inventory and assessment, and notification to local residents of significant risk from nearby sources of air toxics. In 1992, SB 1731 required owners of certain significant risk facilities identified under AB 2588 to reduce the risk below the level of significance.

4. Emission Rates of HAPs/TACs

A number of sources are available for estimating the emission rates for HAPs and TACs from IC engines. Using the formaldehyde emission factors listed in Ventura County APCD's AB 2588 Combustion Emission Factors document, the 10 tons per year major source threshold under the federal CAA may be exceeded if a facility has natural gas-fired engines with a combined rating exceeding about 8,000 horsepower. If this major source threshold is exceeded for an engine that is a stationary source, the engine is subject to federal MACT standards. More recent source testing of engines using natural gas, landfill gas, or field gas indicates the 10 tons per year may be exceed if a facility has engines with a combined rating as low as 4,000 horsepower. This is a worse plausible case, though, as these tests also indicate some facilities may not exceed 10 tons until the combined horsepower rating is as high as 200,000. These data demonstrate that emission rates of HAPs can vary greatly, depending on the type of gaseous fuel, and the design and operating parameters of each individual engine.

5. Control of HAPs/TACs

The toxic substances of most concern emitted from stationary engines burning gaseous fuels are VOCs. These VOCs are the result of incomplete combustion, and can be reduced by methods that either improve combustion inside the engine or destroy VOCs in the exhaust. The VOC emission limits found in this determination will help limit emissions of toxic compounds that are also VOCs.

One of the more popular and effective VOC exhaust control methods for IC engines is the oxidation catalyst. Oxidation catalysts have been shown to reduce VOC emissions by over 90 percent for natural gas-fired engines. Testing conducted on SI engines fueled by liquified petroleum gas and gasoline and with three-way catalysts have indicated substantial reductions in emissions of formaldehyde, acetaldehyde, benzene, 1,3 butadiene, and styrene, all classified as VOCs and HAPs. U.S. EPA's ICCR effort is in the process of testing natural-gas-fired IC engines to determine the effectiveness of oxidation catalysts in controlling HAPs. This testing also will include a rich burn engine with a three-way NSCR catalyst.

Engine modifications that promote complete combustion will reduce emissions of VOCs, thereby also reducing emissions of toxic substances that are VOCs. These engine modifications for natural gas-fired engines include operation of the engine with a lean (but not excessively lean) air/fuel ratio, and the use of improved ignition systems. However, operating an engine slightly lean will tend to maximize NOx emissions.

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APPENDIX A

DETERMINATION OF
RACT AND BARCT FOR STATIONARY SPARK-IGNITED IC ENGINES

DETERMINATION OF REASONABLY AVAILABLE CONTROL TECHNOLOGY AND BEST AVAILABLE RETROFIT CONTROL TECHNOLOGY FOR STATIONARY SPARK-IGNITED INTERNAL COMBUSTION ENGINES

I. Applicability

Except as provided in Section IV. (Exemptions), the provisions of this determination are applicable to all stationary spark-ignited internal combustion engines with a current rating of 50 brake horsepower or greater, or a maximum fuel consumption of 0.52 million Btu per hour or greater based on a brake specific fuel consumption (BSFC) rating of 10,400 Btu per brake horsepower-hour. For stationary spark-ignited internal combustion engines with different BSFC ratings, the maximum fuel consumption should be adjusted accordingly.

II. Definitions

A. ***ANNUAL*** means any consecutive twelve-month period.

B. ***BEST AVAILABLE RETROFIT CONTROL TECHNOLOGY (BARCT)*** means Best Available Control Technology as defined in the California Health and Safety Code, Section 40406.

C. ***CALENDAR YEAR*** means the time period from January 1 through December 31.

D. ***CYCLICALLY-LOADED ENGINE*** means an engine that under normal operating conditions has an external load which varies by 40 percent or more of rated brake horsepower during any load cycle or is used to power an oil well reciprocating pump including beam-balanced or crank-balanced pumps.

E. ***DISASTER OR STATE OF EMERGENCY*** means a fire, flood, earthquake, or other similar natural catastrophe.

F. ***DISTRIBUTED GENERATION (DG)*** refers to relatively small power plants, such as IC engine gensets, which are used to generate electrical power that is either fed into the power grid or used on-site. DG units are located throughout the grid and are usually sited in or close to load centers or utility customers' sites. Distributed generation also refers to a mechanical drive system consisting of one or more IC engines and electric motors, where use of the IC engines or electric motors is interchangeable.

G. ***EMERGENCY STANDBY ENGINE*** is an engine which operates as a temporary replacement for primary mechanical or electrical power during an unscheduled outage caused by sudden and reasonably unforeseen natural disasters or other events beyond the control of the operator. An engine shall not be considered to be an emergency standby engine if it is used for purposes other than: periodic maintenance, periodic readiness testing, readiness testing during and after repair work, unscheduled outages, or to supply power while maintenance is performed or repairs are made to the primary power supply. An engine shall not be considered to be an emergency standby engine if it is used:

(1) to reduce the demand for electrical power when normal electrical power line service has not failed, or

(2) to produce power for the utility electrical distribution system, or

(3) in conjunction with a voluntary utility demand reduction program or interruptible power contract.

H. ***ENGINE*** is any spark-ignited reciprocating internal combustion engine.

I. ***EXEMPT VOC COMPOUNDS*** means carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, ammonium carbonate, and the following compounds:

(1) methane,
methylene chloride (dichloromethane),
1,1,1-trichloroethane (methyl chloroform),
trichlorofluoromethane (CFC-11),
dichlorodifluoromethane (CFC-12),
1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113),
1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC)-114,
chloropentafluoroethane (CFC-115),
chlorodifluoromethane (HCFC-22),
1,1,1-trifluoro-2,2-dichloroethane (HCFC-123),
1,1-dichloro-1-fluoroethane (HCFC-141b),
1-chloro-1,1-difluoroethane (HCFC-142b),
2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124),
trifluoromethane (HFC-23),
1,1,2,2-tetrafluoroethane (HFC-134),
1,1,1,2-tetrafluoroethane (HFC-134a),
pentafluorethane (HFC-125),
1,1,1-trifluoroethane (HFC-143a),
1,1-difluoroethane (HFC-152a),
cyclic, branched, or linear completely methylated siloxanes,
the following classes of perfluorocarbons:

(a) cyclic, branched, or linear, completely fluorinated alkanes;

(b) cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;

(c) cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and

(d) sulfur-containing perfluorocarbons with no unsaturations and with the sulfur bonds to carbon and fluorine, and

(2) The following low-reactive organic compounds which have been exempted by the U.S. EPA:
acetone
ethane
methyl acetate
parachlorobenzotrifluoride (1-chloro-4-trifluoromethyl benzene)
perchloroethylene (tetrachloroethylene).

Methylated siloxanes and perfluorocarbon compounds shall be assumed to be absent from a product or process unless a manufacturer or facility operator identifies the specific individual compounds (from the broad classes of methylated siloxanes and perfluorocarbon compounds) and the amounts present in the product or process and provides a validated test method which can be used to quantify the specific compounds.

J. ***EXHAUST CONTROLS*** are devices or techniques used to treat an engine's exhaust to reduce emissions, and include (but are not limited) to catalysts, afterburners, reaction chambers, and chemical injectors.

K. ***FACILITY*** is one or more parcels of land in physical contact, or separated solely by a public roadway:

(1) all of which are under the same ownership or operation, or which are owned or operated by entities which are under common control; and

(2) belong to the same industrial grouping, either by virtue of falling within the same two-digit standard industrial classification code or are part of a common industrial process, manufacturing process, or connected process involving a common raw material; and

(3) upon which one or more stationary engines operate.

L. ***FUEL*** means any substance which when burned or combusted in an SI engine supplies power and which includes but is not limited to gasoline, natural gas, methane, ethane, propane, butane, and liquefied petroleum gas (LPG).

M. ***LEAN-BURN*** means a spark-ignited engine where the manufacturers original recommended air-to-fuel ratio operating range is fuel-lean of stoichiometry, and the engine normally operates with an exhaust oxygen concentration of greater than 2 percent.

N. ***NONROAD ENGINE*** means a nonroad engine as defined by the U.S. EPA in 40 CFR Part 89, Subpart A, Section 89.2. The term “nonroad” is synonymous with offroad.

O. ***OFFROAD ENGINE*** means a nonroad engine.

P. ***PORTABLE ENGINE*** as defined in Health and Safety Code, Section 41751 means an engine which is designed and capable of being carried or moved from one location to another. Indicators of portability include, but are not limited to, wheels, skids, carrying handles, lifting eyes, dolly, trailer, or platform mounting. The engine is not considered portable if the engine is attached to a foundation or will reside at a fixed location for more than 12 consecutive months or operates during the full annual operating period of a seasonal source.

Q. ***ppmv*** is parts per million by volume at dry conditions.

R. ***RATED BRAKE HORSEPOWER (bhp)*** of an engine is the maximum continuous rating for that engine specified by the manufacturer, based on SAE test 1349 or a similar standard, without taking into account any deratings.

S. ***REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)*** means an emission limitation based upon “reasonably available” devices, systems, process modifications, or other apparatus or techniques taking into account environmental impacts, technological feasibility, and cost-effectiveness. RACT is required in nonattainment areas that are classified as moderate for the State ozone standard.

T. ***RICH-BURN*** means a spark-ignited engine that is not a lean-burn engine.

U. ***SPARK-IGNITED ENGINE*** means a liquid or gaseous fueled engine designed to ignite its air/fuel mixture by a spark across a spark plug.

V. ***STATIONARY INTERNAL COMBUSTION ENGINE*** is an engine which is neither portable nor self-propelled and is operated at a single facility.

W. ***STOICHIOMETRY*** means the precise air-to-fuel ratio where sufficient oxygen is supplied to completely combust fuel.

X. ***VOLATILE ORGANIC COMPOUND (VOC)*** is any compound containing at least one atom of carbon, except exempt compounds.

Y. ***WASTE GAS*** is any untreated, raw gas derived through a natural process, such as anaerobic digestion, from the decomposition of organic waste at municipal solid waste landfills or a publicly-owned waste water treatment facilities. Waste gas includes landfill gas which is generated at landfills, digester gas which is generated at sewage treatment facilities, or a combination of the two.

III. Requirements

A. RACT emissions, corrected to 15 percent oxygen on a dry basis and averaged over 15 minutes, shall not exceed the following limits for the appropriate engine type:

Table A-1

Summary of RACT Standards for Stationary Spark-Ignited Internal Combustion Engines

Spark-Ignited Engine Type	% Control of NO_X	ppmv AT 15% O_2		
		NO_X	VOC	CO
Rich-Burn				
Cyclically-loaded, Field Gas Fueled	--	300	250	4,500
All Other Engines	90	50	250	4,500
Lean-Burn				
Two Stroke, Gaseous Fueled, Less Than 100 Horsepower	--	200	750	4,500
All Other Engines	80	125	750	4,500

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(1) For NOx, either the percent control or the ppmv limit must be met by each engine where applicable. The percent control option applies only if a percentage is listed, and applies to engines using either combustion modifications or exhaust controls. For engines with exhaust controls, the percent control shall be determined by measuring concurrently the NOx concentration upstream and downstream from the exhaust control. For engines without external control devices, the percent control shall be based on source test results for the uncontrolled engine and the same engine after the control device or technique has been employed. In this situation, the engine's typical operating parameters, loading, and duty cycle shall be documented and repeated at each successive post-control source test to ensure that the engine is meeting the percent reduction limit. The ppmv limits for VOC and CO apply to all engines.

(2) California Reformulated Gasoline shall be used as the fuel for all gasoline-fired, spark-ignited engines.

B. BARCT emissions, corrected to 15 percent oxygen on a dry basis and averaged over 15 minutes, shall not exceed the following limits for the appropriate engine type:

Table A-2

Summary of BARCT Standards for Stationary Spark-Ignited Internal Combustion Engines

Spark-Ignited Engine Type	**% Control of NO_X**	**ppmv AT 15% O_2**		
		NO_X	**VOC**	**CO**
Rich-Burn				
Waste Gas Fueled	90	50	250	4,500
Cyclically-loaded, Field Gas Fueled	--	300	250	4,500
All Other Engines	96	25	250	4,500
Lean-Burn				
Two Stroke, Gaseous Fueled, Less Than 100 Horsepower	--	200	750	4,500
All Other Engines	90	65	750	4,500

(1) For NOx, either the percent control or the ppmv limit must be met by each engine where applicable. The percent control option applies only if a percentage is listed, and applies to engines using either combustion modifications or exhaust controls. The percent control shall be determined by measuring concurrently the NOx concentration upstream and downstream from the exhaust control. For engines without external control devices, the percent control shall be based on source test results for the uncontrolled engine and the same engine after the control device or technique has been employed. In this situation, the engine's typical operating parameters, loading, and duty cycle shall be documented and repeated at each successive post-control source test to ensure that the engine is meeting the percent reduction limit. The ppmv limits for VOC and CO apply to all engines.

(2) California Reformulated Gasoline shall be used as the fuel for all gasoline-fired, spark-ignited engines.

IV. Exemptions

A. The provisions of this determination shall not apply to:

(1) The operation of any engine while being used to preserve or protect property, human life, or public health during the existence of a disaster or state of emergency, such as a fire or flood.
(2) Portable Engines.
(3) Nonroad engines excluding nonroad engines used in stationary applications.

B. The provisions of this determination, except for Section VII.B.(2), shall not apply to:

(1) Engines whose total annual hours of operation do not exceed 200 hours as determined by a nonresettable elapsed operating time meter and which are not used to generate electrical power that is either fed into the electrical utility power grid or used to reduce electrical power purchased by a facility; to generate mechanical power that is used to reduce electrical power purchased by a facility; or in a distributed generation application; or
(2) Emergency standby engines that, excluding periods of operation during unscheduled power outages, do not exceed 100 hours of operation annually as determined by a nonresettable elapsed operating time meter. During periods of non-emergency operation, these engines shall not generate electrical power that is either fed into the electrical utility power grid or used to reduce electrical power purchased by a facility; generate mechanical power to reduce electrical power purchased by a facility; or be used in a distributed generation application.

V. Compliance Schedule

The owner or operator of one or more stationary internal combustion engines shall comply with the applicable parts of Sections III. and VII. of this determination in accordance with the following schedule:

A. For each engine to be permanently removed from service and not replaced by another IC engine:

(1) by (6 months after district rule adoption date), submit a statement to the Air Pollution Control Officer identifying the engine to be removed;
(2) by (3 years after district rule adoption date), remove or replace the engine with an electric motor.

B. For all other engines subject to this determination:

(1) by (6 months after district rule adoption date), submit an emission control plan for Air Pollution Control Officer approval;
(2) by (9 months after district rule adoption date), receive approval from the Air Pollution Control Officer for the emission control plan;
(3) by (1 year after district rule adoption date), have all required applications for permits to construct submitted and deemed complete by the Air Pollution Control Officer;
(4) by (2 years after district rule adoption date), have engines and stack modifications, including applicable monitoring systems, under compliance in accordance with an approved emission control plan.

VI. Test Methods

A. The following test methods shall be used to determine oxygen content, oxides of nitrogen emissions, volatile organic compound emissions, and carbon monoxide emissions during source tests:

O_2: ARB Method 100 or U.S. EPA Method 3A
NOx: ARB Method 100 or U.S. EPA Method 7E
VOC: ARB Method 100 or U.S. EPA Method 25A or 25B
CO: ARB Method 100 or U.S. EPA Method 10

B. Alternative test methods which are shown to accurately determine the concentration of NOx, VOC, and CO in the exhaust of IC engines may be used upon the written approval of the Executive Officer of the California Air Resources Board and the Air Pollution Control Officer.

VII. Administrative

A. Emission Control Plan

The owner or operator of a stationary internal combustion engine subject to both Sections III and V.B. of this determination shall submit an emissions control plan to the Air Pollution Control Officer for approval.

(1) The plan shall describe all actions, including a schedule of increments of progress, which will be taken to meet the applicable emissions limitations in Section III. and the compliance schedule in Section V.B. Such plan shall also contain the following information for each engine where applicable:
(a) district permit or identification number;
(b) name of engine manufacturer;
(c) model designation;
(d) rated brake horsepower;

(e) engine type and fuel type (e.g., natural gas-fired rich-burn);
(f) total hours of operation in the previous one-year period, including typical daily operating schedule;
(g) fuel consumption (cubic feet of gas or gallons of liquid) for the previous one year period;
(h) stack modifications to facilitate continuous in-stack monitoring and source testing;
(i) type of controls to be applied, including in-stack monitoring specifications;
(j) the applicable emission limits; and
(k) documentation showing existing emissions of NOx, VOC, and CO.

(2) The emission control plan shall include an inspection and monitoring (I&M) plan. The I&M plan shall include procedures requiring the owner or operator to establish ranges for control equipment parameters, engine operating parameters, and engine exhaust oxygen concentrations that source testing has shown result in pollutant concentrations within the rule limits. The inspection and monitoring plan shall include monthly emissions checks by a procedure specified by the Air Pollution Control Officer. It is recommended that engine owner/operators monitor NOx and oxygen exhaust emission readings using a portable NOx analyzer. If a portable analyzer is used, it shall be calibrated, maintained and operated in accordance with the manufacturer's specifications and recommendations or a protocol approved by the Air Pollution Control Officer. The applicable control equipment parameters and engine operating parameters will be inspected and monitored monthly in conformance with a regular inspection schedule listed in the I&M plan. If an engine owner or operator or district staff find an engine to be operating outside the acceptable range for control equipment parameters, engine operating parameters, engine exhaust NOx, CO, VOC or oxygen concentrations, the owner/operator is required to take corrective actions on the noncompliant parameter(s) within 15 days. The I&M plan shall also include preventive and corrective maintenance procedures. Before any change in operations can be implemented, the I&M plan must be revised as necessary, and the revised plan must be submitted to and approved by the Air Pollution Control Officer.

B. Monitoring and Recordkeeping

(1) The owner or operator of one or more stationary internal combustion engines subject to both Sections III, and V.B. of this determination shall meet the following requirements:

(a) For each stationary internal combustion engine with a rated brake horsepower of 1,000 or greater and which is permitted to operate more than 2,000 hours per calendar year, the owner or operator shall install, operate, and maintain in calibration a continuous NOx and O_2 monitoring system, as approved by the Air Pollution

Control Officer, to demonstrate compliance with the emissions limits of this rule. This system shall determine and record exhaust gas NOx concentrations in ppmv, corrected to 15 percent oxygen. The continuous monitoring system may be a continuous emissions monitoring system (CEMS), parametric emissions monitoring system (PEMS), or an alternative approved by the Air Pollution Control Officer. Adequate verification of the alternative continuous monitoring system's acceptability must be submitted to the Air Pollution Control Officer. This would include data demonstrating the system's accuracy under typical operating conditions for the specific application and any other information or data deemed necessary in assessing the acceptability of the continuous monitoring system. CEMS shall meet the applicable federal requirements described in 40 CFR Part 60. These include the performance specifications found in Appendix B, Specification 2, the quality assurance requirements found in Appendix F, and the reporting requirements of Parts 60.7(c), 60.7(d), and 60.13.

(b) Data collected through the I&M plan described in Section VII.A.(2) shall be in a form approved by the Air Pollution Control Officer, and shall have retrieval capabilities as approved by the Air Pollution Control Officer. The monitoring system described in Section VII.B.(1) shall have data gathering and retrieval capability approved by the Air Pollution Control Officer. All data collected pursuant to the requirements of Section VII.A.(2) and VII.B.(1) shall be maintained for at least two years and made available for inspection by the Air Pollution Control Officer or the Officer's designee.

(c) The owner or operator shall arrange for and assure that an emissions source test is performed on each stationary internal combustion engine at least once every 24 months. In addition, the owner or operator shall arrange for and assure that an initial emissions source test is performed on each stationary internal combustion engine to verify compliance with Section III. by the date specified in Section V.B.(4). Emissions source testing shall be conducted at an engine's actual peak load and under the engine's typical duty cycle. Prior to any source test required by this rule, a source test protocol shall be prepared and submitted to the Air Pollution Control Officer. In addition to other information, the source test protocol shall describe which critical parameters will be measured, and how the appropriate range for these parameters shall be established and incorporated into the I&M plan described in Section VII.A.(2). The source test protocol shall be approved by the Air Pollution Control Officer prior to any testing. VOC shall be reported as methane. VOC, NOx, and CO concentrations shall be reported in ppmv, corrected to 15 percent oxygen. For engines using exhaust controls, NOx shall also be reported as a percent reduction across the control device. All source test reports shall be submitted to the Air Pollution Control Officer or the Officer's designee.

(d) During any quarter in which a source test is not performed, a portable NOx analyzer shall be used to take NOx emission readings to verify compliance with the emission limits or percent control specified in Section III. All emission readings shall be taken at an engine's actual peak load and under the engine's typical duty cycle. The analyzer shall be calibrated, maintained and operated in accordance with the manufacturer's specifications and recommendations or a protocol approved by the Air Pollution Control Officer. An instrument reading in excess of the emission compliance values shall not be considered a violation, so long as the engine is brought into compliance within 15 days of the initial out-of-compliance reading. All NOx readings shall be reported to the Air Pollution Control Officer or the Officer's designee in a manner specified by the Air Pollution Control Officer.

(2) Any engine subject to this determination including those subject to Section IV.B. shall be required to install a nonresettable fuel meter and a nonresettable elapsed operating time meter. The owner or operator may use an alternative device, method, or technique in determining monthly fuel consumption provided the alternative is approved by the Air Pollution Control Officer. The owner or operator shall assure that these required meters are maintained in proper operating condition and shall maintain an engine operating log that includes, on a monthly basis, the total hours of operation and fuel type (e.g, natural gas, gasoline, LPG) and quantity of fuel used. The fuel meter shall be calibrated periodically per the recommendations of the manufacturer. For emergency standby engines, all hours of non-emergency and emergency operation shall also be reported along with the fuel usage. This information shall be available for inspection at any time, and shall be submitted to the Air Pollution Control Officer at the end of each calendar year in a manner and form approved by the Air Pollution Control Officer.

APPENDIX B

DESCRIPTION OF SPARK-IGNITED IC ENGINE OPERATION AND EMISSION CONTROLS

I. DESCRIPTION OF SPARK-IGNITED IC ENGINES

The main parts of a piston-type (also known as reciprocating) spark-ignited (SI) internal combustion (IC) engine include pistons, combustion chambers, a crankshaft, and valves or ports. IC engines generate power from the combustion of an air/fuel mixture. The combusted mixture drives the piston, which is connected by a rod to the crankshaft, so that the back-and-forth motion of the piston is converted into rotational energy at the crankshaft. This rotational energy drives power equipment such as pumps, compressors, or electrical generators.

There are several key aspects of engine design and operation that influence emissions and emissions control. These include the basic design of the engine, the manner in which combustion is initiated, the type of fuel used, the introduction of intake air, the air/fuel ratio, and the operational mode of the engine. A brief description of these aspects is given below.

A. Basic Engine Design

Piston-type internal combustion engines are generally classified as either four or two stroke. Four operations occur in all piston-type internal combustion engines: intake, compression, power, and exhaust. Four stroke engines require two revolutions of the crankshaft to complete all four operations, while two stroke engines require only one revolution.

In four stroke engines, a single operation is associated with each movement of the piston. During the intake stroke, the intake valve opens, and gas is drawn into the combustion chamber and cylinder by the downward motion of the piston. In carbureted and indirect fuel injected engines, fuel is mixed with air before being introduced into the combustion chamber, and thus the gas drawn into the combustion chamber is an air/fuel mixture. In direct gas injection engines, the fuel is injected into the combustion chamber while air is drawn in by the downward motion of the piston. At or shortly after the end of this downward movement, the valves close and the compression stroke begins with the pistons moving upward, compressing the air/fuel mixture. A spark plug ignites the air/fuel mixture. During the power stroke, the hot, high-pressure gases from combustion push the pistons downward. The exhaust stroke begins when the piston nears its full downward position. At that point, the exhaust valves open, and the piston reverses its motion, moving upward to push the exhaust gases out of the combustion chamber. Near the full upward travel of the pistons, the exhaust valves close, the intake valves open, and the intake stroke is repeated.

In a two stroke engine, instead of intake valves, there are one or more ports (i.e., openings) in each cylinder wall that are uncovered as the piston nears its full downward movement. Two stroke engines use either exhaust valves similar to four stroke engines, or exhaust ports located in each cylinder wall across from the intake ports. When the pistons reach their full downward travel, both the intake ports and the exhaust ports or valves are open, and the exhaust gases are swept out by the air/fuel mixture that is transferred into the cylinder through the intake ports. In order to effect this transfer, the intake air must be pressurized. This operation is often referred to as scavenging. The pressurization can result from introducing the air into a sealed crankcase. An air/fuel mixture is pulled into the sealed crankcase through the upward movement of the piston, and is pressurized by the downward movement of the piston. Alternatively, a supercharger or turbocharger can be used to compress the intake air. The compression and power strokes for a two-stroke engine are similar to those for a four-stroke engine.

B. Combustion Initiation

In SI engines, (also called Otto cycle), the fuel is usually mixed with intake air before introduction into the combustion chamber, resulting in a relatively homogeneous air/fuel mixture in the combustion chamber. Once the spark plug initiates combustion, the homogeneous mixture propagates the flame throughout the combustion chamber during the power stroke.

C. Type of Fuel

SI engines can use natural gas, landfill gas, digester gas, field gas, refinery gas, propane, methanol, ethanol, gasoline, or a mixture of these fuels. Natural gas consists almost exclusively of methane. Field gas refers to the raw gas produced from oil or gas production fields and contains varying amounts of hydrogen sulfide which can clog exhaust catalysts and render them ineffective in controlling NOx. Refinery gas refers to the gas generated by oil refinery processing. Field gas and refinery gas consist of mostly methane, but contain more of the heavier gaseous hydrocarbon compounds than natural gas. Landfill gas is generated from the decomposition of waste materials deposited in landfills. Landfill gas can vary from 25 to 60 percent methane, with the remainder being mostly inert gases such as carbon dioxide and nitrogen. Digester gas is generated from the anaerobic digestion of solids at sewage treatment plants. Digester gas is typically about two-thirds methane, while the remaining one-third is mostly inert gases such as carbon dioxide.

Significant amounts of gaseous sulfur compounds may also be present in landfill and digester gas. The sulfur content of the fuel is important, as exhaust catalysts may be adversely affected by high levels of sulfur. In addition, waste gases may contain methylated siloxanes which could poison or mask exhaust catalysts.

D. Introduction of Intake Air

On many engines, the intake air is compressed by a supercharger or turbocharger before it enters the combustion chamber. This compression can increase engine power substantially.

The major parts of a turbocharger consist of a turbine and compressor. Exhaust gases from the combustion chamber which are under high temperature and pressure pass through the exhaust pipe into the turbine, causing the turbine blades to spin. The turbine is connected by a shaft to a compressor. Intake air is directed into the compressor, where it is pressurized before passing through the intake manifold into the combustion chamber. The turbocharger allows the engine to pass a greater mass of air through the combustion chamber, which allows more fuel to be added and more power to be produced. Turbocharging also improves the overall efficiency of an engine.

Superchargers work in a similar fashion to turbochargers, except a mechanical power drive off the engine rather than exhaust gas powers the compressor. Less power is required to run a turbocharger than a comparable supercharger, and therefore turbocharged engines tend to be slightly more efficient than supercharged engines.

Engines not equipped with turbochargers or superchargers are referred to as naturally aspirated. Two stroke engines sometimes use superchargers to displace exhaust with intake air, but this design generally does not result in any significant pressurization of the intake air, and such engines are also classified as naturally aspirated.

E. Air/Fuel Ratio

Another basic engine parameter is the air/fuel ratio. Stoichiometry is defined as the precise air-to-fuel ratio where sufficient oxygen is supplied to completely combust fuel. A stoichiometric air/fuel ratio provides exactly enough oxygen to fully atomize the fuel for complete combustion. Rich of stoichiometry refers to fuel-rich combustion, i.e., operation at any air-to-fuel ratio less than stoichiometry. Lean of stoichiometry refers to fuel-lean combustion, i.e., operation at any air-to-fuel ratio numerically higher than stoichiometry.

Two-stroke, spark-ignited engines are lean-burn, while naturally aspirated, four-stroke SI engines are generally rich-burn. Turbocharged, spark-ignited engines can be either rich-burn or lean-burn, depending on design. Lean-burn engines tend to be more efficient but larger in size and higher in capital cost than rich-burn engines of the same power output. Also, smaller engines tend to be rich-burn, while larger engines tend to be lean-burn.

SI engines exhibit peak thermal efficiency (and also peak NOx emissions) at an air/fuel ratio that is about 6 to 12 percent leaner than stoichiometric. Efficiency (and NOx emissions) decrease if the mixture becomes leaner or richer than this peak efficiency ratio (see Figure B-1). If the mixture is enriched, NOx emissions can be reduced to about 50 percent of their peak value before encountering problems with excessive emissions of CO, VOC, and possibly smoke. If the mixture is leaned from the peak efficiency air/fuel ratio, significant NOx reductions are possible.

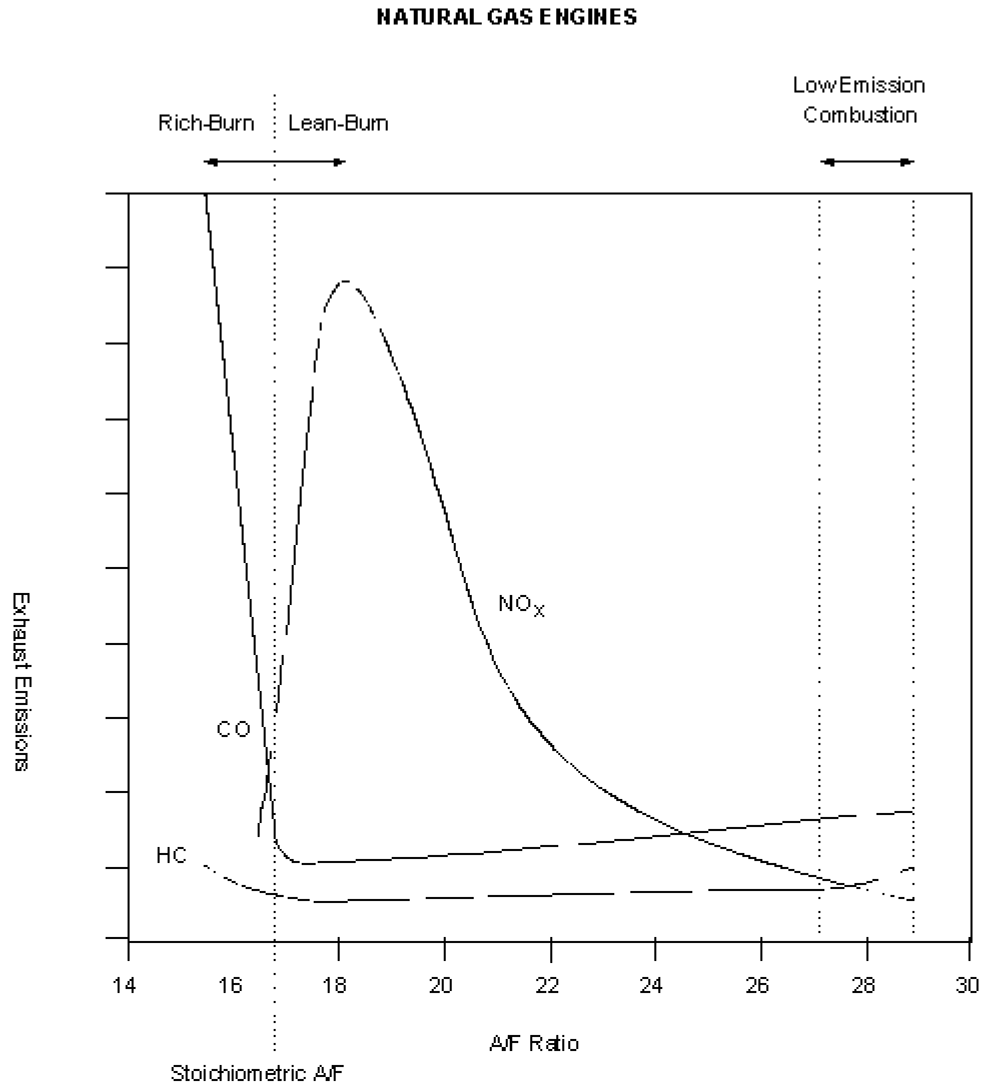

Figure B-1: The Effect of Air-to-Fuel Ratio on NOx, CO, and HC Emissions
(Provided by GRI)

As the mixture is leaned, at some point the engine will have difficulty in initiating combustion of the lean air/fuel mixture. One of the more popular methods of overcoming ignition difficulties with lean mixtures is to incorporate precombustion chambers into the engine head. A precombustion chamber is a small combustion chamber which contains the spark plug. A rich mixture is introduced into the precombustion chamber, which is ignited by the spark plug. Passageways from the precombustion chamber to the main combustion chamber allow the flame front to pass into and ignite the lean mixture in the main combustion chamber. Precombustion chambers used alone or in combination with other NOx reduction technologies are known as low-emission combustion. This approach is described in more detail later in this appendix.

Another method used to assist combustion of lean mixtures (especially in smaller engines) is to redesign the intake manifold and combustion chamber to promote more thorough mixing, so that a more uniform air/fuel mixture is present in the combustion chamber. A third method is to use an improved ignition system that sparks either more frequently or continuously.

F. Operational Mode

Reciprocating IC engines can be used in several operational modes. In many cases, they are used continuously under a constant power load, shutting down only when there is a breakdown, or when maintenance or repair work is required. Other engines operate cyclically, changing their power output on a regular, frequent schedule. One of the more common cyclic applications is an oil well pump, where an engine may operate at load for a time period varying from several seconds to about 20 seconds, followed by an equal amount of time operating at idle.

Some engines may operate continuously, but for only part of the year. In many cases, this intermittent operation is seasonal. In other cases, engines are portable, and are used only for a specific, short-term need. In still other cases, engines are used infrequently, for emergency purposes. Such engines may operate for no more than a few hours per year during an emergency, and are also tested routinely, typically for less than an hour once a week. Other engines may operate in modes that combine the characteristics of cyclic and continuous operations.

The operational mode of the engine is an important consideration when adopting control regulations. The operational mode may impact operating parameters such as exhaust gas temperature, which often must be taken into account when designing and applying controls. The operational mode may also affect the impact of emissions on air quality. For instance, an engine that operates only during summer, which is the peak ozone season, will have a much greater impact on ambient air quality violations than an engine with the same annual emissions that operates year round.

II. DESCRIPTION OF IC ENGINE CONTROLS

Combustion of fossil fuels results in emissions of criteria pollutants and their precursors (i.e., NOx, CO, particulate matter, VOC, and sulfur oxides (SOx)). Controls for one pollutant sometimes increases the emissions of one or more other pollutants. If this occurs, controls can often be used for these other pollutants which will fully mitigate the increase. SOx is generally controlled by limiting the sulfur content of the fuel and is not discussed further in this determination, except as it affects emissions of other pollutants.

The following discussion of controls emphasizes the control of NOx. NOx emissions from stationary engines are generally far greater than for the other four pollutants.

NOx is generated in internal combustion engines almost exclusively from the oxidation of nitrogen in the air (thermal NOx) and from the oxidation of fuel-bound nitrogen (fuel NOx). The generation of fuel NOx varies with the nitrogen content of the fuel and the air/fuel ratio. The generation of thermal NOx varies with the air/fuel ratio, flame temperature, and residence time. Most fuels used in IC engines have relatively low fuel-bound nitrogen, so the principal NOx generation mechanism is thermal NOx. Even in cases where a high nitrogen content fuel such as crude oil or residual fuel oil is used, thermal NOx generation is generally far greater than fuel NOx generation due to the high combustion temperatures present.

There are probably more different types of controls available to reduce NOx from IC engines than for any other type of NOx source. These controls can be placed into one of four general categories: combustion modifications, fuel switching, post combustion controls, and replacement with a low emissions engine or electric motor. These controls are discussed in the following sections.

A. Combustion Modifications

Combustion modifications can reduce NOx formation by using techniques that change the air/fuel mixture, reduce peak temperatures, or shorten the residence time at high temperatures. The most frequently used combustion modifications include retarding the ignition, leaning the air/fuel ratio, adding a turbocharger and aftercooler, and adding exhaust gas recirculation.

Emissions of CO, particulate matter, and VOC are generally the result of incomplete combustion. They can be controlled by combustion modifications that increase oxygen, temperature, residence time at high temperatures, and the mixing of air and fuel. Note, however, that many of these modifications tend to increase NOx emissions. Care must be taken when applying these modifications to assure that reductions in one pollutant do not result in an unacceptable increase in other pollutants. These pollutants can also be controlled by post combustion controls such as oxidation catalysts and particulate traps.

1. Ignition Timing Retard

Applicability: This technique can be used on all spark-ignited (SI) engines. The technique has been widely used on motor vehicle engines, but is less popular on stationary source engines.

Principle: The ignition is retarded in SI engines by delaying the electrical pulse to the spark plug. As a result, the spark plug fires later, resulting in more of the combustion taking place as the piston begins its downward movement. This reduces both the magnitude and duration of peak temperatures.

Typical Effectiveness: NOx reductions for ignition timing retard are approximately 15 to 30 percent.

Limitations: SI engines are more sensitive than CI engines to operational problems associated with timing retard, and SI engines with excessive retard tend to misfire and exhibit poor transient performance. NOx reductions can be achieved with this technique, but there are limitations. Ignition timing should be retarded per the engine manufacturer's specifications and recommendations in order to avoid problems during engine operation.

Other Effects: Ignition timing retard will result in greater fuel consumption and higher exhaust temperatures, which could cause excessive exhaust valve wear. The maximum power output of the engine is also reduced, but this reduction is generally minor. Ignition timing retard will also result in greater emissions of VOC and HAPs.

Costs: This method has relatively low capital and operating costs. The cost of adjusting timing to retard the ignition should be less than $300.

2. Air/Fuel Ratio Changes

Applicability: This technique can be used on all SI engines, and has been used extensively on a wide variety of engines.

Principle: NOx formation is a strong function of the air/fuel ratio as shown in Figure B-1. Emissions of CO and VOC are also strong functions of the air/fuel ratio. Stoichiometry is achieved when the air/fuel ratio is such that all the fuel can be fully oxidized with no residual oxygen remaining. NOx formation is highest when the air/fuel ratio is slightly on the lean side of stoichiometric. At this point, both CO and VOC are relatively low. Adjusting the air/fuel ratio toward either leaner or richer mixtures from the peak NOx formation air/fuel ratio will reduce NOx formation. In the case of leaner mixtures, the excess air acts as a heat sink, reducing peak temperatures, which results in reduced NOx formation. The excess air also allows more oxygen to come into contact with the fuel, which promotes complete combustion and reduces VOC and CO emissions. As the mixture continues to be leaned out, the reduced temperatures may result in a slight increase in CO and VOC emissions. For extremely lean mixtures, misfiring will occur, which increases VOC emissions dramatically.

Operating the engine on the lean side of the NOx formation peak is often preferred over operating rich because of increased fuel efficiencies associated with lean operation. When adjusting the air/fuel ratio, once an engine is leaned beyond the peak NOx air/fuel ratio, there is approximately a 5 percent decrease in NOx for a 1 percent increase in intake air. However, this rate of decrease in NOx becomes smaller as the mixture becomes leaner. Leaning the mixture beyond the optimal air/fuel ratio associated with peak fuel efficiency will result in increased fuel consumption. Compared to the most efficient air/fuel ratio, there is a fuel consumption penalty of about 3 percent when an engine is leaned sufficiently to reduce NOx by 50 percent. Fuel consumption increases exponentially if the mixture is leaned further.

NOx formation will also decrease if the mixture is richened from the peak NOx air/fuel ratio. However, the effect on NOx is generally not as great as that associated with leaning the mixture. With richer mixtures, the available oxygen preferentially combines with the fuel to form carbon dioxide (CO_2) and water (H_2O), leaving less oxygen available to combine with nitrogen to form NOx. A mixture richer than stoichiometric will result in incomplete combustion. Nearly all the oxygen will then combine with the fuel, emissions of CO and VOC will increase, and reductions in peak temperatures will reduce NOx formation. There is a very rapid exponential increase in CO and VOC emissions as the mixture becomes richer than stoichiometric.

The use of very lean air/fuel ratios may result in ignition problems. For this reason, techniques designed to improve ignition are often combined with lean air/fuel ratios to control NOx emissions and avoid increases in VOC emissions. These other techniques are described on the following pages.

Typical Effectiveness: When leaning of the mixture is combined with other techniques such as low-emission combustion retrofit, NOx reductions greater than 80 percent are achievable, along with reductions in CO and VOC emissions. If extremely lean mixtures are used in conjunction with engine derating, NOx reductions well above 80 percent (less than 65 ppmv) are achievable. For extremely lean mixtures the resulting reduced temperatures will tend to inhibit oxidation, which will increase CO and VOC emissions to some degree.

For rich mixtures, the NOx reduction potential is not as great as reductions for lean mixtures. As the mixture is richened, emissions of CO and VOC increase to unacceptable levels before the NOx decreases to levels achieved by leaning the mixture.

Limitations: If the air/fuel mixture is richened excessively, emissions of CO and VOC increase dramatically. If the air/fuel ratio is leaned excessively, the flammability limit may be exceeded, resulting in misfiring. When an engine misfires (i.e., fails to fire), uncombusted fuel enters the exhaust, which dramatically increases VOC emissions.

Other Effects: None known.

Costs: Changing the air/fuel ratio of a SI engine should cost no more than $300. There is generally a fuel penalty for rich-burn engines that are richened, but leaning the mixture may reduce fuel consumption. These fuel effects vary with the engine and the degree of change in the air/fuel mixture.

3. Low-Emission Combustion/Precombustion Chamber Retrofit

Applicability: This control technology can be used on all SI engines, and has had wide applications on a variety of engines.

Principle: This method is used to enhance the effectiveness of the air/fuel ratio method described previously. As indicated previously in the discussion of air/fuel ratio changes, leaning the air/fuel mixture from the optimal NOx producing ratio will reduce NOx formation. The leaner the mixture, the lower the NOx emissions. However, to obtain substantial reductions in NOx emissions, engine modifications are needed to assure that the fuel will ignite and to minimize any fuel consumption penalties. A number of engine manufacturers and NOx control equipment manufacturers offer retrofit kits for some makes and models of lean-burn and rich-burn engines that allow these engines to operate on extremely lean mixtures to minimize NOx emissions. These retrofits are often referred to as low-emission combustion retrofits.

On smaller engines, the cylinder head and pistons can be redesigned to promote improved swirl patterns which result in thorough mixing. On larger engines, the use of a precombustion chamber (also referred to as a prechamber) is needed to ignite the lean mixture. Combustion begins in the smaller prechamber, which contains the spark plug and a rich air/fuel mixture. Combustion propagates into the larger main chamber, which contains a lean air/fuel mixture. The resulting peak temperatures are lower due to: 1) the rich ignition mixture, 2) heat transfer losses as combustion proceeds into the main chamber, and 3) the dilution effects of the excess air.

Many precombustion chamber retrofits consist of replacing the existing engine heads with new heads. However, some low cost prechamber retrofits are designed to use the existing engine's head, with the prechambers fitted into the existing spark plug hole. Other prechamber retrofits consist of a modified spark plug instead of a separate prechamber. The modified spark plug has a small, built-in fuel nozzle which injects fuel toward the spark plug electrode.

In order to achieve these leaner air/fuel ratios, additional amounts of air must be introduced into the engine when using a given amount of fuel. For naturally aspirated engines, a turbocharger often must be added to provide the additional air. In other cases, the existing turbocharger may have to be replaced or modified to increase the air throughput.

Other equipment may also be used in a low-emission combustion retrofit, such as a high energy ignition system to eliminate or minimize misfiring problems associated with lean operation, a new or modified aftercooler, and an air/fuel ratio controller. This equipment is described in more detail on the following pages.

Typical Effectiveness: For natural gas-fired engines, in almost all cases NOx emissions can be reduced to less than 130 parts per million (ppm) (i.e., greater than an 80 percent reduction over uncontrolled levels) with little or no fuel penalty. If engine parameters are adjusted and carefully controlled and the maximum power output of the engine is derated, sustained emissions below 65 ppm are achievable.

Limitations: NOx reductions of roughly 80 percent over uncontrolled levels are achievable with little or no fuel penalty. However, if the engine is leaned further to reduce emissions by more than about 80 percent, the fuel penalty increases exponentially. In some cases, a turbocharger may be needed to provide increased air flow, but a properly sized turbocharger may not be available for a retrofit. In other cases, the available retrofit parts may not allow the engine to produce the same maximum power, and the engine must be derated. Beyond a certain degree of leaning (and NOx reduction), misfiring will become a problem.

In some cases, it may be cheaper to replace an existing engine with a new low-emission combustion engine, rather than install a retrofit kit. This is especially true if the retrofit kit has to be developed for that particular make and model of engine, or if the existing engine is old, inefficient, or unreliable.

Other Effects: At extremely lean air/fuel ratios, VOC and CO emissions tend to increase slightly. Once the air/fuel mixture is sufficiently lean, misfiring may occur, in which case VOC emissions can increase substantially.

Costs: For the installation of precombustion chamber heads and related equipment on large (~ 2,000 horsepower) engines, capital costs are about $400,000 per engine, and installation costs are about $200,000. Costs are lower for smaller engines. In terms of dollars per rated brake horsepower (bhp), costs are about $250/bhp for the large engines, and tend to be higher than this for smaller engines.

For prechambers fitted inside the existing spark plug hole, capital costs are about $15,000 to $20,000 for engines in the 300 to 400 horsepower range. Capital costs for engines in the 2,000 horsepower range can exceed $200,000.

4. <u>Ignition System Improvements</u>

Applicability: This control technology can be used on all SI engines. It has been applied to only a limited number of engines and engine types.

Principle: This method is used in conjunction with the use of lean air/fuel ratios to reduce NOx emissions. It allows leaner mixtures to be used without misfiring problems. As indicated previously, the leaner the air/fuel ratio, the lower the NOx emissions. However, at some point in leaning the mixture, lean misfire begins to occur, and further NOx reductions are impractical. In most engines during ignition, a nonuniform air/fuel mixture passes by the spark plug. In standard ignition systems, the spark plug's firing duration is extremely short. If the spark plug fires when this mixture is too lean to support combustion, a misfire occurs. If the spark plug fires multiple times, or for a longer period of time, there is a greater chance that the proper air/fuel mixture will pass by the spark plug and ignite the mixture. Improved ignition systems generally use a higher voltage to fire the spark plug, in addition to multiple or continuous sparking of the spark plug. This allows the use of leaner air/fuel ratios, resulting in lower NOx emissions.

Typical Effectiveness: Emission reductions from a combination of leaning of the air/fuel mixture and use of a continuous sparking ignition system approach but are generally less than a precombustion chamber retrofit. NOx emissions can generally be reduced to about 200 ppm.

Limitations: If the air/fuel ratio is leaned excessively, misfiring can occur. As with all methods involving leaning, the engine's maximum power rating may have to be reduced unless a turbocharger is retrofitted to naturally aspirated engines or the existing turbocharger is modified or replaced to increase the throughput of combustion air. In many cases, a separate retrofit kit must be developed for each make and model of engine, and only a few kits have been developed so far.

Other Effects: At extremely lean air/fuel ratios, VOC and CO emissions tend to increase slightly. If the air/fuel mixture is leaned excessively, misfiring may occur, in which case VOC emissions can increase substantially.

Costs: Costs are about two-thirds that of a precombustion chamber retrofit involving head replacement. For large engines (~ 2000 horsepower), costs can be in excess of $200,000.

5. Turbocharging or Supercharging and Aftercooling

Applicability: This control method can be used on almost any engine and is widely used.

Principle: Turbochargers and superchargers compress the intake air of an engine before this air enters the combustion chamber. Due to compression, the temperature of this air is increased. This tends to increase peak temperatures, which increases the formation of NOx. However, the heat sink effect of the additional air in the cylinder, combined with the increased engine efficiency from turbocharging or supercharging, generally results in a minor overall decrease in NOx emissions per unit of power output. On the other hand, turbocharging or supercharging can significantly increase the maximum power rating of an engine, which increases the maximum mass emissions rate for NOx. Due to the high density of oxygen in the combustion chamber, turbocharging or supercharging makes the combustion process more effective, which tends to reduce emissions of CO and VOC.

On turbocharged or supercharged engines, the intake air temperature can be reduced by aftercooling (also known as intercooling or charge air cooling). An aftercooler consists of a heat exchanger located between the turbocharger or supercharger and combustion chamber. The heat exchanger reduces the temperature of the intake air after it has been compressed by the supercharger or turbocharger. Cooling the intake air reduces peak combustion temperatures, and thereby reduces NOx emissions. The cooling medium can be water, either from the radiator or from a source outside of the engine, or the cooling medium can be ambient air. The use of radiator water generally results in the least amount of cooling, while the use of outside water or ambient air results in the most cooling of the intake air. Using either a cooler source of water or ambient air for the aftercooler can reduce the intake air temperature to as low as 90 ^{o}F.

The cooling effects of the aftercooler increases the density of the intake air, which results in a leaner air/fuel mixture in SI engines if no additional fuel is introduced. For engines already using lean air/fuel mixtures, this leaner mixture will lower NOx emissions further.

Typical Effectiveness: NOx reductions from aftercooling range from about 3 to 35 percent. The percentage reduction is roughly proportional to the reduction in temperature. Reductions in VOC and CO emissions also occur.

Limitations: Turbochargers or superchargers may not be available for some engines. In addition, some internal engine parts may have to be replaced or strengthened when adding a supercharger or turbocharger.

Other Effects: Use of a supercharger or turbocharger increases the efficiency and maximum power rating of an engine. Use of an aftercooler further increases the efficiency of an engine, and can also increase the maximum power rating. At low loads and excessive temperature reductions, an aftercooler can cause longer ignition delays, which increase emissions of VOC and particulate matter. This emissions increase can be minimized if an aftercooler bypass is used to limit cooling at low loads.

Costs: The cost of retrofitting a naturally aspirated engine with a turbocharger and related equipment varies from engine to engine. These costs vary not only because different sizes of turbochargers are used for different engines, but also because different engines may require more extensive internal modifications.

For natural gas engines, costs of a turbocharger retrofit are typically $30,000 to $40,000 for engines in the 800 to 900 horsepower range. For natural gas engines in the 1,100 to 1,300 horsepower range, costs can vary from $35,000 to $150,000.

In some cases, replacement of an existing engine with a new, low NOx emitting turbocharged engine may result in lower overall costs than retrofitting the existing engine with a turbocharger or supercharger. Although the capital cost of the new engine will generally be greater than the retrofit cost for the existing engine, the new engine will reduce overall costs due to increased efficiency, reduced down time, and reduced maintenance and repair costs.

Except in cases where an engine's usage factor is very low, the improved fuel efficiency associated with the use of turbochargers, superchargers, and aftercoolers generally results in a cost savings.

6. Exhaust Gas Recirculation

Applicability: Exhaust gas recirculation, or EGR, can be used on all engine types. It has been widely used on gasoline motor vehicle engines, but has been used infrequently on engines used in other applications.

Principle: EGR can be external or internal. In the case of external EGR, a portion of the exhaust gas is diverted from the exhaust manifold and routed to the intake manifold before reentering the combustion chamber. For internal EGR, an engine's operating parameters (such as valve timing or supercharger pressure) are adjusted so that a greater amount of exhaust remains in the cylinder after the exhaust stroke.

EGR reduces NOx emissions by decreasing peak combustion temperatures through two mechanisms: dilution and increased heat absorption. Dilution of the fuel/air mixture slows the combustion process, thereby reducing peak temperatures. In addition, exhaust gases contain significant amounts of carbon dioxide and water vapor, which have a higher heat capacity than air. This means that, compared to air, carbon dioxide and water vapor can absorb greater amounts of heat without increasing as much in temperature.

Typical Effectiveness: NOx reductions are limited to about 30 percent before operation of the engine is adversely affected.

Limitations: EGR will reduce an engine's peak power. This may be a serious problem for engines required to operate at or near their peak power rating. The EGR system must be designed and developed for each make and model of engine. An EGR retrofit kit is not available for most engines.

Other Effects: EGR reduces engine efficiency. For example, fuel efficiency decreases about 2 percent for a 12 percent decrease in NOx emissions.

Costs: Costs are typically greater than for timing retard, but less than a turbocharger retrofit.

7. Prestratified Charge

Applicability: This control technology is applicable to spark-ignited rich-burn engines. This method converts rich-burn engines into lean burn engines. It has been used on a number of different engines, but is not as widely used as some of the most popular controls, such as low-emission combustion or NSCR catalysts.

Principle: Rich-burn engines are typically four stroke naturally aspirated engines with no intake/exhaust overlap. The major components of a prestratified charge (PSC) retrofit are the air injectors. These injectors pulse air into the intake manifold in such a fashion that layers or zones of air and the air/fuel mixture are introduced into the combustion chamber. Once inside the combustion chamber, the top zone, near the spark plug, contains a rich air/fuel mixture. The bottom zone is an air layer. The most recent version of the PSC system operates off of engine vacuum, which allows the system to automatically compensate for varying power outputs.

The PSC technique is very similar in concept to a precombustion chamber. Both have a rich fuel mixture near the spark plug, and a lean mixture elsewhere in the combustion chamber. NOx emissions are low for PSC for the same reasons they are low for prechamber designs.

Typical Effectiveness: PSC can achieve greater than 80 percent control of NOx for power outputs up to about 70 or 80 percent of the maximum (uncontrolled) power rating using air injection only.

Limitations: In order for the engine to generate more than 70 or 80 percent of the maximum (uncontrolled) power rating, the air injection rate must be reduced. This results in a richer fuel mixture, which increases NOx emissions. To maintain high NOx control at high power outputs, a turbocharger may have to be added or the existing turbocharger may have to be modified or replaced to increase air throughput. Maximum emission reductions, even with use of a turbocharger, are generally lower than can be accomplished with the use of an NSCR catalyst.

Other Effects: Fuel efficiency may be improved because PSC effectively converts a rich-burn engine into a lean-burn engine.

Costs: For engines in the 300 to 900 horsepower range, retrofit costs are typically about $30,000. For engines in the 1100 to 1600 horsepower range, retrofit costs are about $40,000. However, costs can double if a turbocharger is added. Retrofits for even larger engines where a turbocharger is added can cost as much as $160,000 to $190,000.

B. Fuel Switching

NOx emissions from IC engines can be reduced by switching to fuels that burn at lower temperatures, such as methanol.

1. Methanol

Applicability: This control method is applicable to all engine types. Although a number of motor vehicle engines have been converted to methanol fuel, very few stationary source engine conversions have taken place.

Principle: NOx emissions are generally lower for methanol than for other fuels for several reasons. Methanol has a higher heat of vaporization than other fuels, and thus the process of vaporization cools the air/fuel mixture significantly, resulting in lower peak temperatures. Methanol, being a partially oxygenated fuel, burns with a lower flame temperature, which also reduces peak temperatures. Methanol fuel consists of only one type of molecule, which makes it easier to optimize the combustion process in comparison to fuels consisting of a wide variety of molecules, such as gasoline or diesel. Methanol and natural gas combustion produces almost no particulate matter.

For rich-burn methanol engines, a relatively inexpensive three-way catalyst like that used in gasoline-engined motor vehicles can be installed to control NOx. Methanol can also be used as a fuel for lean-burn spark-ignited engines. Methanol has a wider range of flammability than many other fuels, allowing a leaner mixture to be used, resulting in greater NOx reductions than is possible with other fuels.

Methanol can be used as a replacement fuel for gaseous and gasoline fueled engines with only relatively minor engine modifications.

Typical Effectiveness: NOx reductions from the conversion of an engine to methanol fuel depend on the pre-conversion engine and fuel type. NOx reductions range from about 30 percent for the conversion of a natural gas engine. Reductions are even greater when the conversion is accompanied by the addition of a catalyst.

Limitations: A retrofit kit must be developed for each make and model of engine. Currently, there are very few conversion kits available. The fuel and engine system must use materials that are resistant to the corrosive action of methanol. Special lubricants must be used to avoid excessive engine wear. Incomplete combustion of methanol produces formaldehyde, but the use of an oxidation catalyst can reduce formaldehyde emissions to low levels.

Other Effects: None for SI engines.

Costs: Conversion costs for an automotive engine are on the order of $1,000. Costs for converting stationary gasoline engines to methanol are expected to be similar. The largest cost element is often is the fuel price differential between methanol and the fuel it replaces (e.g., natural gas or gasoline). Included in this price differential are transportation, storage, and refueling costs associated with the use of methanol.

C. Post Combustion Controls

Post combustion controls generally consist of catalysts or filters that act on the engine exhaust to reduce emissions. Post combustion controls also include the introduction of agents or other substances that act on the exhaust to reduce emissions, with or without the assistance of catalysts or filters.

1. Oxidation Catalyst

Applicability: This control method is applicable to all engines. For stationary engines, oxidation catalysts have been used primarily on lean-burn engines. Rich-burn engines tend to use 3-way catalysts, which combine nonselective catalytic reduction (NSCR) for NOx control and an oxidation catalyst for control of CO and VOC. The oxidation catalyst has been used on lean-burn engines for nearly 30 years. Oxidation catalysts are used less frequently on stationary engines. In the United States, only about 500 stationary lean-burn engines have been fitted with oxidation catalysts.

Principle: An oxidation catalyst contains materials (generally precious metals such as platinum or palladium) that promote oxidation reactions between oxygen, CO, and VOC to produce carbon dioxide and water vapor. These reactions occur when exhaust at the proper temperature and containing sufficient oxygen passes through the catalyst. Depending on the catalyst formulation, an oxidation catalyst may obtain reductions at temperatures as low as 300 or 400 ^{o}F, although minimum temperatures in the 600 to 700 ^{o}F range are generally required to achieve maximum reductions. The catalyst will maintain adequate performance at temperatures typically as high as 1350 ^{o}F before problems with physical degradation of the catalyst occur. In the case of rich-burn engines, where the exhaust does not contain enough oxygen to fully oxidize the CO and VOC in the exhaust, air can be injected into the exhaust upstream of the catalyst.

Typical Effectiveness: The effectiveness of an oxidation catalyst is a function of the exhaust temperature, oxygen content of the exhaust, amount of active material in the catalyst, exhaust flow rate through the catalyst, and other parameters. Catalysts can be designed to achieve almost any control efficiency desired. Reductions greater than 90 percent for both CO and VOC are typical. Reductions in VOC emissions can vary significantly and are a function of the fuel type and exhaust temperature.

Limitations: A sufficient amount of oxygen must be present in the exhaust for the catalyst to operate effectively. In addition, the effectiveness of an oxidation catalyst may be poor if the exhaust temperature is low, which is the case for an engine at idle. Oxidation catalysts, like other catalyst types, can be degraded by masking, thermal sintering, or chemical poisoning by sulfur or metals. If the engine is not in good condition, a complete engine overhaul may be needed to ensure proper catalyst performance.

Sulfur, which can be found in fuels and lubricating oils, is generally a temporary poison, and can be removed by operating the catalyst at sufficiently high temperatures. However, high temperatures can damage the substrate material. Other ways of dealing with sulfur poisoning include the use of low sulfur fuels or scrubbing of the fuel to remove the sulfur. Besides being a catalyst poison, sulfur can also be converted into sulfates by the catalyst before passing through the exhaust pipe. Catalysts can be specially formulated to minimize this conversion, but these special formulations must operate over a relatively narrow temperature range if they are to effectively reduce VOC and CO and also suppress the formation of sulfates. For engines operated over wide power ranges, where exhaust temperatures vary greatly, special catalyst formulations are not effective.

Metal poisoning is generally more permanent, and can result from the metals present in either the fuel or lubricating oil. Specially formulated oils with low metals content are generally specified to minimize poisoning, along with good engine maintenance practices. Metal poisoning can be reversed in some cases with special procedures. Many catalysts are now formulated to resist poisoning.

Masking refers to the covering and plugging of a catalyst's active material by solid contaminants in the exhaust. Cleaning of the catalyst can remove these contaminants, which usually restores catalytic activity. Masking is generally limited to engines using landfill gas, diesel fuel, or heavy liquid fuels, although sulfate ash from lubricating oil may also cause masking. Masking can be minimized by passing the exhaust through a particulate control device, such as a filter or trap, before this material encounters the catalyst. In the case of landfill gas, the particulate control device can act directly on the fuel before introduction into the engine.

Thermal sintering is caused by excessive heat and is not reversible. However, it can be avoided by incorporating over temperature control in the catalyst system. Many manufacturers recommend the use of over temperature monitoring and control for their catalyst systems. In addition, stabilizers such as CeO_2 or La_2O_3 are often included in the catalyst formulation to minimize sintering. High temperature catalysts have been developed which can withstand temperatures exceeding 1800 ^oF for some applications. This temperature is well above the highest IC engine exhaust temperature that would ever be encountered. Depending on the design and operation, peak exhaust temperatures for IC engines range from 550 to 1300 ^oF.

Other recommendations to minimize catalyst problems include monitoring the pressure drop across the catalyst, the use of special lubricating oil to prevent poisoning, periodic washing of the catalyst, the monitoring of emissions, and the periodic laboratory analysis of a sample of catalyst material.

Other Effects: A catalyst will increase backpressure in the exhaust, resulting in a slight reduction in engine efficiency and maximum rated power. However, when conditions require an exhaust silencer, the catalyst can often be designed to do an acceptable job of noise suppression so that a separate muffler is not required. Under such circumstances, backpressure from the catalyst may not exceed that of a muffler, and no reduction in engine efficiency or power occur. Often, engine manufacturers rate their engines at a given backpressure, and as long as the catalyst does not exceed this backpressure, no reduction in the engine's maximum power rating will be experienced.

Costs: Typical costs for an oxidation catalyst are 10 to 12 dollars per horsepower, or slightly less than a nonselective catalytic reduction (NSCR) catalyst. The cost for catalyst wash service has been reported as $300 to $600 per cubic foot of catalyst material.

2. Nonselective Catalytic Reduction (NSCR)

Applicability: This control method is applicable to all rich-burn engines, and is probably the most popular control method for rich-burn engines. The first wide scale application of NSCR technology occurred in the mid- to late-1970s, when 3-way NSCR catalysts were applied to motor vehicles with gasoline engines. Since then, this control method has found widespread use on stationary engines. NSCR catalysts have been commercially available for stationary engines for over 15 years, and over 3,000 stationary engines in the U.S. are now equipped with NSCR controls. Improved NSCR catalysts, called 3-way catalysts because CO, VOC, and NOx are simultaneously controlled, have been commercially available for stationary engines for over 10 years. Over 1,000 stationary engines in the U.S. are now equipped with 3-way NSCR controls.

The dual bed NSCR catalyst is a variation of the 3-way catalyst. The dual bed contains a reducing bed to control NOx, followed by an oxidizing bed to control CO and VOC. Dual bed NSCR catalysts tend to be more effective than 3-way catalysts, but are also more expensive, and have not been applied to as many engines as 3-way catalysts. Improved 3-way catalysts can approach the control efficiencies of dual bed catalysts at a lower cost, and for this reason dual bed catalysts have lost popularity to 3-way catalysts.

Principle: The NSCR catalyst promotes the chemical reduction of NOx in the presence of CO and VOC to produce oxygen and nitrogen. The 3-way NSCR catalyst also contains materials that promote the oxidation of VOC and CO to form carbon dioxide and water vapor. To control NOx, CO, and VOC simultaneously, 3-way catalysts must operate in a narrow air/fuel ratio band (15.9 to 16.1 for natural gas-fired engines) that is close to stoichiometric. An electronic controller, which includes an oxygen sensor and feedback mechanism, is often necessary to maintain the air/fuel ratio in this narrow band. At this air/fuel ratio, the oxygen concentration in the exhaust is low, while concentrations of VOC and CO are not excessive.

For dual bed catalysts, the engine is run slightly richer than for a 3-way catalyst. The first catalyst bed in a dual bed system reduces NOx. The exhaust then passes into a region where air is injected before entering the second (oxidation) catalyst bed. NOx reduction is optimized in comparison to a 3-way catalyst due to the higher CO and VOC concentrations and lower oxygen concentrations present in the first (reduction) catalyst bed. In the second (oxidation) bed, CO and

VOC reductions are optimized due to the relatively high oxygen concentration present. Although the air/fuel ratio is still critical in a dual bed catalyst, optimal NOx reductions are achievable without controlling the air/fuel ratio as closely as in a 3-way catalyst.

Typical Effectiveness: Removal efficiencies for a 3-way catalyst are greater than 90 percent for NOx, greater than 80 percent for CO, and greater than 50 percent for VOC. Greater efficiencies, below 10 parts per million NOx, are possible through use of an improved catalyst containing a greater concentration of active catalyst materials, use of a larger catalyst to increase residence time, or through use of a more precise air/fuel ratio controller.

For dual bed catalysts, reductions of 98 percent for both NOx and CO are typical.

The previously mentioned reduction efficiencies for catalysts are achievable as long as the exhaust gases are within the catalyst temperature window, which is typically 700 to 1200 ^{o}F. For many engines, this temperature requirement is met at all times except during startup and idling.

The percentage reductions are essentially independent of other controls that reduce the NOx concentration upstream of the catalyst. Thus, a combination of combustion modifications and catalyst can achieve even greater reductions.

Limitations: As with oxidation catalysts, NSCR catalysts are subject to masking, thermal sintering, and chemical poisoning. In addition, NSCR is not effective in reducing NOx if the CO and VOC concentrations are too low. NSCR is also not effective in reducing NOx if significant concentrations of oxygen are present. In this latter case, the CO and VOC in the exhaust will preferentially react with the oxygen instead of the NOx. For this reason, NSCR is an effective NOx control method only for rich-burn engines.

When applying NSCR to an engine, care must be taken to ensure that the sulfur content of the fuel gas is not excessive. The sulfur content of pipeline-quality natural gas and LPG is very low, but some oil field gases and waste gases can contain high concentrations. Sulfur tends to collect on the catalyst, which causes deactivation. This is generally not a permanent condition, and can be reversed by introducing higher temperature exhaust into the catalyst or simply by heating the catalyst. Even if deactivation is not a problem, the water content of the fuel gas must be limited when significant amounts of sulfur are present to avoid deterioration and degradation of the catalyst from sulfuric acid vapor.

For dual bed catalysts, engine efficiency suffers slightly compared to a 3-way catalyst due to the richer operation of engines using dual bed catalysts.

In cases where an engine operates at idle for extended periods or is cyclically operated, attaining and maintaining the proper temperature may be difficult. In such cases, the catalyst system can be designed to maintain the proper temperature, or the catalyst can use materials that achieve high efficiencies at lower temperatures. For some cyclically operated engines, these design changes may be as simple as thermally insulating the exhaust pipe and catalyst.

Most of these limitations can be eliminated or minimized by proper design and maintenance. For example, if the sulfur content of the fuel is excessive, the fuel can be scrubbed to remove the sulfur, or the catalyst design or engine operation can be modified to minimize the deactivation effects of the sulfur. Poisoning from components in the lube oil can be eliminated by using specially formulated lube oils that do not contain such components. However, NSCR applications on landfill gas and digester gas have generally not been successful due to catalyst poisoning and plugging from impurities in the fuel.

Other Effects: A very low oxygen content in the exhaust must be present for NSCR to perform effectively. To achieve this low oxygen content generally requires richening of the mixture. This richening tends to increase CO and VOC emissions. However, use of a 3-way catalyst can reduce CO and VOC emissions to levels well below those associated with uncontrolled engines.

Another effect of NSCR is increased fuel consumption. This increase is very slight when compared to an uncontrolled rich-burn engine. However, when compared to a lean-burn engine, a rich-burn engine uses 5 to 12 percent more fuel for the same power output. If a rich-burn engine uses a dual bed catalyst, a further slight increase in fuel consumption is generally experienced.

Costs: The total installed cost of an NSCR system on an existing engine varies with the size of the engine. The catalyst will cost about 8 to 15 dollars per horsepower, while air/fuel ratio controllers vary in cost from about $3,500 to $7,000. Installation and labor costs generally range from $1,000 to $3,000. For an 80 horsepower engine, total costs for installation may range from $5,000 to $11,000. For an 1,100 horsepower engine, installed costs of $20,000 to $25,000 are typical.

3. Hybrid System

Applicability: This control method can be applied to all engines. This control method was conceived by Radian Corporation, and has been developed by AlliedSignal and Beaird Industries. There has been one field prototype demonstration in San Diego, and it appears that the system has been offered commercially. However, there are no commercial applications of this technique.

Principle: The hybrid system is a modification of the dual bed NSCR system. The hybrid system adds a burner in the engine exhaust between the engine and the dual bed catalysts. The burner is operated with an excess amount of fuel so that oxygen within the engine exhaust is almost completely consumed, and large amounts of CO are generated. The exhaust then passes through a heat exchanger to reduce temperatures before continuing on to a reducing catalyst. The NOx reduction efficiency of the reducing catalyst is extremely high due to the high CO concentration (the CO acts as a reducing agent to convert NOx into nitrogen gas. The exhaust next passes through another heat exchanger, and air is added before the exhaust passes through an oxidation catalyst. The oxidation catalyst is extremely efficient in reducing CO and VOC emissions due to the excess oxygen in the exhaust.

Typical Effectiveness: NOx concentrations as low as 3 to 4 ppm are achievable with this system. Concentrations of CO and VOC are typical of systems using oxidation catalysts.

Limitations: When the oxygen content of the engine's exhaust is high, such as for lean-burn engines, the burner must use a large amount of fuel to consume nearly all the oxygen and generate sufficient amounts of CO. Therefore, use of this method on lean-burn engines is only practical in cogeneration applications, where heat generated by the burner can be recovered and converted to useful energy.

Other Effects: For rich-burn engines, this method has a fuel penalty of about one to five percent. However, for lean-burn engines, the fuel penalty could be equal to the uncontrolled engine's fuel consumption.

Costs: Costs are several times greater than for a simple NSCR catalyst. Capital costs were reported in 1993 as $150,000 for a 470 brake horsepower engine.

4. Selective Catalytic Reduction (SCR)

Applicability: This method was patented in the U.S. in the 1950s, and there have been over 700 applications of SCR to combustion devices worldwide. Some of these applications include stationary IC engines. However, most of these applications are external combustion devices such as boilers. SCR systems for IC engines have been commercially available for a number of years, but there have only been a few dozen SCR retrofits of IC engines. SCR is applicable to all lean-burn engines, including diesel engines.

Principle: The exhaust of lean-burn engines contains high levels of oxygen and relatively low levels of VOC and CO, which would make an NSCR type of catalyst ineffective at reducing NOx. However, an SCR catalyst can be highly effective under these conditions. Oxygen is a necessary ingredient in the SCR NOx reduction equation, and SCR performs best when the oxygen level in the exhaust exceeds 2 to 3 percent.

Differing catalyst materials can be used in an SCR catalyst, depending on the exhaust gas temperature. Base metal catalysts are most effective at exhaust temperatures between 500 and 900 ^{o}F. Base metal catalysts generally contain titanium dioxide and vanadium pentoxide, although other metals such as tungsten or molybdenum are sometimes used. Zeolite catalysts are most effective at temperatures between 675 to over 1100 ^{o}F. Precious metal catalysts such as platinum and palladium are most effective at temperatures between 350 and 550 ^{o}F.

In SCR, ammonia (or, in some cases, urea) is injected in the exhaust upstream of the catalyst. The catalyst promotes the reaction of ammonia with NOx and oxygen in the exhaust, converting the reactants to water vapor and nitrogen gas. Ammonia injection can be controlled by the use of a NOx monitor in the exhaust downstream of the catalyst. A feedback loop from the monitor to the ammonia injector controls the amount injected, so that NOx reductions are maximized while emissions of ammonia are minimized. To eliminate the use of a costly NOx monitor, some applications use an alternative system that measures several engine parameters. Values for these parameters are then electronically converted into estimated NOx concentrations.

Typical Effectiveness: The NOx removal efficiency of SCR is typically above 80 percent when within the catalyst temperature window.

Limitations: SCR can only be used on lean burn engines. Relatively high capital costs make this method too expensive for smaller or infrequently operated engines.

Some SCR catalysts are susceptible to poisoning from metals or silicon oxides that may be found in the fuel or lubricating oil. Poisoning problems can be minimized by using specially formulated lubricating oils that do not contain the problem metals, the use of fuels with low metals or silicon oxides content, or the use of zeolite catalysts which are not as susceptible to poisoning.

If platinum or palladium is used as an active catalyst material, the sulfur content of the exhaust must be minimized to avoid poisoning of the catalyst. In addition, for all types of SCR catalysts, high sulfur fuels will result in high sulfur oxides in the exhaust. These sulfur compounds will react with the ammonia in the exhaust to form particulate matter that will either mask the catalyst or be released into the atmosphere. These problems can be minimized by using low sulfur fuel, a metal-based SCR system specially designed to minimize formation of these particulate matter compounds, or a zeolite catalyst.

Ammonia gas has an objectionable odor, is considered an air pollutant at low concentrations, becomes a health hazard at higher concentrations, and is explosive at still higher concentrations. Safety hazards can occur if the ammonia is spilled or there are leaks from ammonia storage vessels. These safety hazards can be minimized by taking proper safety precautions in the design, operation, and maintenance of the SCR system. Safety hazards can be substantially reduced by using aqueous ammonia or urea instead of anhydrous ammonia. If a concentrated aqueous solution of urea is used, the urea tank must be heated to avoid recrystallization of the urea. In addition, if too much ammonia is injected into the exhaust, excessive ammonia emissions may result. These emissions can be reduced to acceptable levels by monitoring and controlling the amount of ammonia injected into the exhaust.

SCR may also result in a slight increase in fuel consumption if the backpressure generated by the catalyst exceeds manufacturer's limits.

Other Effects: None known.

Costs: SCR is one of the higher cost control methods due to the capital cost for the catalyst, the added cost and complexity of using ammonia, and the instrumentation and controls needed to carefully monitor NOx emissions and meter the proper amount of ammonia. Estimated costs, however have been declining over the past several years. Currently, costs are estimated to be about $50 to $125 per horsepower.

Engines operated at a constant load may be able to eliminate the NOx monitor and feedback ammonia metering system. In such cases, proper instrumentation must be used to monitor ammonia and NOx when the SCR system is set up. Frequent checks are also needed to assure that the setup does not change. Such a system was purchased in 1996 for a 1,300 horsepower diesel engine at a cost of approximately $100,000.

5. Lean NOx Catalyst

Applicability: This control method can be used on any lean-burn engine, although development work has concentrated on diesel engines. This control method is still in the development stage and is not commercially available, but may be available in a few years.

Principle: A number of catalyst materials can be used in the formulation of lean NOx catalysts. The constituents are generally proprietary. NOx reductions are generally minimal unless a reducing agent (typically raw fuel) is injected upstream of the catalyst to increase catalyst performance to acceptable levels. Depending on the catalyst formulation, this method can reduce NOx, CO, and VOC simultaneously.

Typical Effectiveness: Claims for NOx control efficiencies have ranged from 25 to 50 percent. Steady state testing on a diesel-fueled engine yielded NOx reductions of 17 to 44 percent.

Limitations: Use of a reducing agent increases costs, complexity, and fuel consumption. The reducing agent injection system must be carefully designed to minimize excess injection rates. Otherwise, emissions of VOC and particulate matter can increase to unacceptable levels. Tests have shown that lean NOx catalysts produce significant amounts of nitrous oxide (N_2O), and that this production increases with increasing NOx reduction efficiencies and reducing agent usage. This method is not commercially available, and is still in the development and demonstration stage.

Other Effects: None known.

Costs: Since no systems have been sold commercially, costs are unknown, but would probably exceed those for NSCR.

6. NOxTech

Applicability: This control method, formerly known as RAPRENOX, is applicable to lean-burn engines. This technology can be applied to lean-burn gaseous fueled engines. However, this technology is relatively new, and there have only been a few commercial applications.

Principle: NOxTech uses a gaseous phase autocatalysis process to reduce NOx and other pollutants. There is no catalyst. In this method a reagent and fuel are injected into a reactor vessel with the exhaust stream of the engine. The fuel combusts and increases the exhaust temperature to a range of 1,400 to 1,550 ^{o}F, where reactions between nitric oxide (NO) and the reagent generate N_2, CO_2, and H_2O. The reactor vessel is a large chamber which increases the residence time of the constituent gases at high temperature. In the past, cyanuric acid has been the reagent. More recent literature indicates that either urea or ammonia is used.

Typical Effectiveness: NOx emission reductions of 80 to 90 percent are typical, and the system can be designed to reduce NOx by well over 90 percent. This control method also removes 80 percent or more of CO, VOCs, and PM as well with minimal reagent slip.

Limitations: With a recovery heat exchanger in the reactor, the fuel penalty is about 5 to 10 percent. There are versions which do not have the heat exchanger. In these versions, significant amounts of fuel are used to heat the exhaust. Although this technology may be economically attractive for cogeneration applications where the energy used to heat the exhaust is recovered, the economics are less favorable for applications where the exhaust heat is not recovered. This technology may not be economically attractive when an engine's power output remains below 50 percent of full power. At low power outputs, exhaust temperatures are low, and greater amounts of fuel must be used to achieve the required exhaust temperature. The size of the reaction chamber may make applications difficult where there is a lack of room.

Other Effects: None known.

Costs: In general, the capital costs for this system are much lower than SCR, but operating costs are significantly higher. Start-up costs are estimated to be in the range of $100 to $200 per kilowatt.

7. Urea Injection

Applicability: This control method is applicable to all lean-burn engines and is also known as selective noncatalytic reduction. It has been used on several boilers to control NOx, but there have been no applications to internal combustion engines.

Principle: Urea injection is very similar to cyanuric acid injection, as both chemicals come in powder form, and both break down at similar temperatures to form compounds which react with nitric oxide. Differences are that a high temperature heating system is not required for urea injection. Instead, the urea is usually dissolved in water, and this solution is injected into the exhaust stream.

Typical Effectiveness: Unknown.

Limitations: The temperature window for urea is higher than the highest exhaust temperature of nearly all engines. Therefore, due to cost-effectiveness considerations, practical applications of urea injection are limited to engines in cogeneration applications. Specifically, these applications are limited to situations where supplemental firing is applied to the engine's exhaust to increase its temperature, and the exhaust heat is recovered and used.

Other Effects: Unknown.

Costs: Unknown.

8. <u>NOx Adsorber Technology (SCONOx</u>)

Applicability: This NOx control method is applicable to diesel-fueled and lean burn engines and is just entering the commercialization phase. It has been installed on gas turbines, boilers, and steam generators previously. The first U.S. application of NOx adsorber technology on a mobile source is the Honda Insight which is a hybrid vehicle. Multiple companies and organizations are engaged in the development of the NOx adsorber technology. This discussion will focus on SCONOx.

Principle: This system uses a single catalyst for the removal of NOx, VOC, and CO emissions. This is a three step process in which initially the catalyst simultaneously oxidizes NO, hydrocarbon, and CO emissions. In the second phase, NO_2 is absorbed into the catalyst surface through the use of a potassium carbonate coating. Unlike SCR, this technology does not require a reagent such as ammonia or urea in reducing emissions. Finally, the catalyst undergoes regeneration periodically to maintain maximum NOx absorption. The SCONOx system requires natural gas, water, and electricity and operates at temperatures ranging from 300? to 700? F.

The catalyst is regenerated by passing a dilute hydrogen reducing gas across its surface in the absence of oxygen. The gases react with the potassium nitrites and nitrates to form potassium carbonate which is the absorber coating on the surface of the catalyst. The exhaust from the regeneration process is nitrogen and steam. This catalyst has multiple sections of catalyst. At any given time, a certain percentage of the sections are in the oxidation/absorption cycle while the remaining catalyst sections are being regenerated. In IC engine applications, one regeneration approach has been to de-sorb the adsorber by running the engine in a fuel rich mode and passing the exhaust through a three way catalyst to reduce the NOx.

Typical Effectiveness: Since this technology is just entering commercialization data is very limited. Feasibility testing conducted by the manufacturer on a diesel engine rated less than

100 horsepower indicated that NOx reductions greater than 90 percent can be achieved. The manufacturer intends to conduct further testing on a demonstration basis. As part of its demonstration for California Environmental Technology Certification, this technology had NOx emissions of 2 ppmv (approximately 98.6 control) on a natural gas-fired gas turbine.

Limitations: The system is sensitive to trace amounts of sulfur in the exhaust. In certifying this technology with a gas turbine, it has been reported that the system achieves it lowest NOx levels by adding a sulfur scrubber to the natural gas fuel. From this statement, it would seem logical that the use of low sulfur diesel fuel would be recommended on IC engines.

Other Effects: Since a reagent is not required as with SCR, there will be no emissions of ammonia which is a toxic compound which can cause health effects. The catalyst is regenerated using hydrogen gas which is generated onsite through the use of a reformer. Hydrogen is flammable and could be a potential safety hazard.

Costs: At this stage of development/commercialization, the cost for a single prototype is estimated to be about $100,000. It is expected that mass production would drop prices substantially.

D. Replacement

Another method of reducing NOx is to replace the existing IC engine with an electric motor, or a new engine designed to emit very low NOx emissions. In some instances, the existing engine may be integral with a compressor or other gear, and replacement of the engine will require the replacement or modification of this other equipment as well.

Applicability: This control method is applicable to all engines.

Principle: Rather than applying controls to the existing engine, it is removed and replaced with either a new, low emissions engine or an electric motor.

Typical Effectiveness: New, low emissions engines can reduce NOx by a substantial amount over older, uncontrolled engines. Potential NOx reductions of over 60 percent can be realized by replacing existing SI engines with new certified low emission engines fueled by natural gas or propane.

Another approach is to replace an engine with an electric motor. An electric motor essentially eliminates NOx emissions associated with the removed engine, although there may be minor increases in power plant emissions to supply electricity to the electric motor.

Limitations: In remote locations or where electrical infrastructure is inadequate, the costs of electrical power transportation and conditioning may be excessive. Similarly, the cost of replacing an engine with a natural gas fired unit could be prohibitive if a natural gas pipeline is not in reasonably close proximity to the engine. In cases where the existing engine operates equipment integral to the engines (such as some engine/compressors that share a common crankshaft), both the engine and integral equipment often must be replaced.

Certified Engines: Another issue to consider is associated with new engines certified to an on road or off road emission standard. A certified engine's NOx emission units is given in g/bhp-hr and is an average of the NOx concentrations measured under different operating conditions of a given test cycle. So the certified engine's NOx emissions could be higher or lower than its certification value depending on the operating mode under which the engine is being tested. In addition, on road test cycles are typically transient in nature which matches the duty cycle of a mobile source whereas an off road cycle is steady state in nature. There is the possibility that the emissions measured using ARB Test Method 100 or U.S. EPA Test Method 7E on a certified engine in a stationary application may not match the engine's NOx certification numbers due to the differences between test cycles and the engine's operational duty cycle.

Other Effects: None known.

Costs: Costs of engine replacement with an electric motor or new low emissions engine are highly variable, and depend on the size of the engine, the cost of electricity, electrical power availability, accessibility of natural gas pipelines, useful remaining life for the existing engine, and other factors.

APPENDIX C

SUMMARY OF DISTRICT IC ENGINE RULES

SUMMARY OF DISTRICT IC ENGINE RULES

Note that this appendix contains summaries of the district rules. Please refer to the actual district rules for complete text.

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	Rule/Measure/Date
	Antelope Valley AQMD **Rule 1110.2** **12/09/1994**
Applicability	All stationary engines > 50 bhp and all portable engines > 100 bhp
Limits	Replace engines with an electric motor, or reduce emissions to the following: **For portable engines and stationary engines that generate electric power, are fired on landfill gas or sewage digester gas, are used for pumping water (except aeration facilities), are fueled by field gas, are integral engine compressors operating fewer than 4000 hours per year, or are LPG-fueled:** NOx – engines ≥ 500 bhp – 36 ppm @ 15% oxygen, engines > 50 and < 500 bhp – 45 ppm @ 15% oxygen VOC – 250 ppm @ 15% oxygen as methane CO – 2000 ppm @ 15% oxygen **For all other stationary engines:** NOx – 36 ppm @ 15% oxygen VOC – 250 ppm @ 15% oxygen as methane CO – 2000 ppm @ 15% oxygen
Exemptions	✍ Engine operation during an officially declared disaster or state of emergency ✍ Agricultural operations ✍ Emergency standby engines which operate fewer than 200 hours per year ✍ Fire fighting and or flood control ✍ Research and testing ✍ Performance verification and testing ✍ Engines locate in some parts of Riverside County ✍ Auxiliary engines used to power engines or gas turbines during start up ✍ Supplemental engines which operate < 700 hours per year for snow making or ski lift operation
Administrative Requirements	✍ Engines > 1000 bhp and operating > 2 million bhp-hr. per year must use continuous emissions monitoring for NOx and CO ✍ Monitoring system shall have data gathering and retrieval capability ✍ Maintain continuous monitoring records for two years ✍ Source testing of NOx, VOC, and CO every year ✍ Maintain operating log ✍ Emission control plan
Monitoring Period	CEMS required for engines > 1000 bhp and > 2 million bhp-hr. per year Source test every year
Test Methods	NOx – EPA Method 20 CO – EPA Method 10 VOC – EPA Method 25

	Rule/Measure/Date
	Bay Area AQMD **Regulation 9, Rule 8** **01/20/1993**
Applicability	≥ 250 bhp; partly or completely gaseous fueled
Limits	CO – 2000 ppmv @ 15% oxygen **Natural gas fuels** ***Rich-burn*** NOx – 56 ppmv @ 15% oxygen ***Lean-burn*** NOx – 140 ppmv @ 15% oxygen **Waste-derived fuels** ***Rich-burn*** NOx – 210 ppmv @ 15% oxygen ***Lean-burn*** NOx – 140 ppmv @ 15% oxygen
Exemptions	✍ Engines used solely as emergency standby sources of power ✍ Engines < 250 bhp ✍ Engines fired exclusively on liquid fuels ✍ Engines used in agricultural operations ✍ Engines ≤ 1000 bhp and < 200 hrs/year operation ✍ Engines > 1000 bhp and < 100 hrs/year operation
Administrative Requirements	✍ Maintain records of hours of operation for engines exempted due to low usage
Monitoring Period	Initial source test required by 3/31/97; results submitted by 5/31/97
Test Methods	NOx – ST-13 A or B CO – ST-6 VOC – ST-14

	Rule/Measure/Date
	El Dorado County APCD **Rule 233** **10/18/1994**
Applicability	> 50 bhp, operated on gaseous fuels, LPG, or diesel
Limits	CO – 2000 ppmv **Rich-Burn** NOx – 90 ppmv @ 15% oxygen **Lean-Burn** NOx – 150 ppmv @ 15% oxygen **Diesel** NOx – 600 ppmv @ 15% oxygen
Exemptions	✍ Agricultural operations ✍ ? 50 bhp engines ✍ Engines operating < 200 hours per year ✍ Emergency standby engines (maintenance limited to 50 hours/year) ✍ Research and testing ✍ Test stands used for evaluating engine performance ✍ Diesel engines with permitted capacity < 15% ✍ Diesel engines used to power cranes and welding equipment
Administrative Requirements	✍ Maintain inspection log ✍ Documentation supporting exemption ✍ Annual emissions report
Monitoring Period	Annual source test
Test Methods	NOx – EPA Method 7E CO – EPA Method 10 O2 – EPA Method 3A

	Rule/Measure/Date
	Kern County APCD **Rule 427** **07/01/1999**
Applicability	≥ 50 bhp; all fuel types
Limits	**For engines > 50 bhp:** Follow required NOx minimization maintenance schedule **For engines > 250 bhp after 6/1/97:** CO – 2000 ppm **@** 15% oxygen **Rich-Burn** NOx – 50 ppm @ 15% oxygen or 90% reduction **Lean-Burn** NOx **--** 125 ppm @ 15% oxygen or 80% reduction, or 2 gm/bhp-hr. if combustion modification used exclusively (125 ppm if no means to measure shaft power output) **Diesel** 600 ppm @ 15% oxygen or 30% reduction If engine efficiency exceeds 30%, ppm limits adjusted higher
Exemptions	✍ Agricultural operations ✍ Emergency standby engines operated < 200 hours per year ✍ Engines used for fire fighting or flood control ✍ Laboratory engines used in research and testing ✍ Engines operated exclusively for performance verification and testing ✍ Portable engines not operated at the same site for more than one year
Administrative Requirements	✍ Emission control plan required ✍ Engine service log ✍ Engine operating log for engines subject to emission limits ✍ Source test required every calendar year
Monitoring Period	For engines > 250 hp: For lean-burn and diesel engines, monitor NOx and CO concentrations, or if catalysts are used, monitor flow rate of reducing compounds or air to fuel ratio Source test annually or if Control Officer is provided with documentation related to NOx emissions showing the engine has been operating as when last tested and the Control Officer has no reason to suspect non-compliance: Every two years; or by testing after no more than 1000 hours of operation
Test Methods	NOx – EPA Method 7E or ARB Method 100 CO – EPA Method 10 or ARB Method 100 O2 – EPA Method 3 or 3A, or ARB Method 100

	Rule/Measure/Date
	Mojave Desert AQMD **Regulation 1160** **10/26/1994**
Applicability	≥ 500 bhp, located in Federal Ozone Nonattainment Area
Limits	CO – 4500 ppmv@ 15% oxygen **Rich-Burn** NOx – 50 ppmv @ 15% oxygen or 90% reduction **Lean-Burn** NOx – 140 ppmv @ 15% oxygen or 80% reduction **Diesel** NOx – 700 ppmv @ 15% oxygen or 30% reduction VOC –106 ppmv@ 15% oxygen, except 255 ppmv @ 15% oxygen at SCG Newberry Spring facility
Exemptions	✍ < 500 bhp ✍ Engines operating < 100 hours over four continuous calendar quarters ✍ Emergency engines ✍ Engines located outside of the Federal Ozone Nonattainment Area
Administrative Requirements	✍ Emission control plan ✍ Maintain log on each engine recording fuel use, maintenance performed, and other information required in Emission Control Plan
Monitoring Period	Engine inspection required once every calendar quarter or after every 2,000 hours of operation, whichever is more frequent Source test required every 12 months
Test Methods	NOx – EPA Method 7E CO – EPA Method 10 VOC – EPA Methods 18, 25, and/or 25A O2 – EPA Method 3A Exempt Compounds – ASTM Method D 4457-85

	Rule/Measure/Date
	Sacramento Metropolitan AQMD **Rule 412** **06/01/1995**
Applicability	≥ 50 bhp, located at major stationary sources
Limits	*RACT Emission Limits after 7/1/95:* **Rich-Burn** NOx – 50 ppmv @ 15% oxygen CO – 4000 ppmv @ 15% oxygen NMHC – 250 ppmv @ 15% oxygen **Lean-Burn** NOx – 125 ppmv @ 15% oxygen CO – 4000 ppmv @ 15% oxygen NMHC – 750 ppmv @ 15% oxygen **Diesel** NOx – 700 ppmv @ 15% oxygen CO – 4000 ppmv @ 15% oxygen NMHC – 750 ppmv @ 15% oxygen *NOx BARCT Emission Limits after 5/31/97:* **Rich-Burn** 25 ppmv @ 15% oxygen or 90% reduction **Lean-Burn** 65 ppmv @ 15% oxygen or 90% reduction **Diesel** 80 ppmv @ 15% oxygen or 90% reduction
Exemptions	✍ Emergency standby ✍ Agricultural operations ✍ Test stands ✍ Emission control evaluation ✍ Non road engines ✍ Motor vehicles ✍ Flight line engines
Administrative Requirements	✍ Operational record required
Monitoring Period	Source test required every 8,760 hours of operation or every 5 years, whichever is shorter
Test Methods	NMHC – EPA Method 25, or 25A and 18 **For spark-ignited engines:** NOx, CO, O2 – ARB Method 100 **For diesel engines:** NOx – EPA Method 7E CO – EPA Method 10 O2 – EPA Method 3A

	Rule/Measure/Date
	San Diego County APCD **Rule 69.4** **11/15/2000**
Applicability	≥ 50 bhp, located at major stationary source
Limits	CO – 4500 ppmv @ 15% oxygen NOx – 50 ppmv @ 15% oxygen, 0.9 g/bhp-hr or 90% reduction (rich-burn, all fuels except waste-derived) NOx – 125 ppmv @ 15% oxygen, 2.3 g/bhp-hr or 80% reduction (lean-burn, also engines using waste-derived fuels) NOx – 700 ppm @ 15% oxygen or 9.0 g/bhp-hr (diesel)
Exemptions	✍ Used in connection with a structure for not more than four families ✍ Agricultural operations ✍ Engines operated within a permitted test cell for gas turbines or IC engines ✍ Engines operated for < 200 hours per year ✍ Emergency standby engines operated ≤ 52 hours per year for non-emergency purposes ✍ Emergency standby engines at nuclear generating stations operated ≤ 200 hours per year for non-emergency purposes ✍ Engines used in conjunction with military tactical support equipment
Administrative Requirements	✍ Maintain maintenance records ✍ Keep operating log for engines exempt due to low usage ✍ Maintain monthly records for engine and control equipment parameters for three years
Monitoring Period	None mentioned
Test Methods	SDCAPCD Test 100, ARB Method 100, or EPA equivalent

	Rule/Measure/Date
	San Diego County APCD **Rule 69.4.1** **11/15/2000**
Applicability	Stationary engines rated ≥ 50 bhp
Limits	CO – 4500 ppmv @ 15% oxygen **Rich Burn** NOx – 25 ppmv @ 15% oxygen or 96% reduction (using fossil-derived gaseous fuel or gasoline) NOx – 50 ppmv @ 15% oxygen or 90% reduction (using waste-derived gaseous fuel) VOC – 250 ppmv @ 15% oxygen **Lean Burn** NOx – 65 ppmv @ 15% oxygen or 90% reduction (using gaseous fuel) **Diesel** NOx – 535 ppmv @ 15% oxygen, 6.9 g/bhp-hr or 90% reduction (high-use, new or replacement low-use and new or replacement cyclic engines) NOx – 700 ppmv @ 15% oxygen, 9.0 g/bhp-hr or 90% reduction (existing low-use or existing cyclic engines)
Exemptions	✍ Used in connection with a structure for not more than four families ✍ Agricultural operations ✍ Engines operated within a permitted test cell for gas turbines or IC engines ✍ Engines operated for < 200 hours per year ✍ Emergency standby engines operated ≤ 52 hours per year for non-emergency purposes ✍ Emergency standby engines at nuclear generating stations operated ≤ 200 hours per year for non-emergency purposes ✍ Military tactical support equipment ✍ Low-use diesel engines with any two of the following: turbocharging, aftercooling, and retarding the injection timing by 4 degrees
Administrative Requirements	✍ Maintain inspection and maintenance records ✍ Keep operating log for exempt engines ✍ Maintain monthly records for engine and control equipment parameters ✍ Non-resettable totalizing fuel meter and non-resettable totalizing time meter required
Monitoring Period	Source test every two years
Test Methods	NOx, CO, CO_2, O_2 **-** SDCAPCD Test 100, ARB Method 100, or EPA equivalent VOC – EPA Method 25A and/or 18 **For engines certified by EPA or ARB:** In compliance until approved test method developed for NOx, CO, CO_2, O_2

	Rule/Measure/Date
	San Joaquin Valley Unified APCD **Rule 4701** **11/12/1998**
Applicability	Engine rated greater than 50 bhp and requiring a permit
Limits	CO – 2000 ppmv@ 15% oxygen *For engines not owned by the Public Water District:* **Rich-Burn except beam-balanced or crank-balanced pumping engines** NOx – 50 ppmv @ 15% oxygen or 90% reduction, VOC – 250 ppmv @ 15% oxygen **Lean-Burn** NOx – 75 ppmv @ 15% oxygen or 85% reduction, VOC – 750 ppmv @ 15% oxygen **Diesel or dual-fuel** NOx -- 80 ppmv @ 15% oxygen or 90% reduction, VOC – 750 ppmv @ 15% oxygen *For engines owned by the Public Water District:* **Rich-Burn except beam-balanced or crank-balanced pumping engines** NOx – 90 ppmv @ 15% oxygen or 80% reduction **Lean-Burn** NOx -- 150 ppmv @ 15% oxygen or 70% reduction **Diesel or dual-fuel** NOx – 600 ppmv @ 15% oxygen or 20% reduction *For beam-balanced or crank-balanced pumping engines:* NOx – 300 ppmv @ 15% oxygen *For waste-gas engines:* NOx -- 125 ppmv @ 15% oxygen or 80% reduction, VOC – 750 ppmv @ 15% oxygen
Exemptions	✍ Agricultural operations ✍ Standby engines ✍ Engines used exclusively for fire fighting or flood control ✍ Laboratory engines used in research and testing ✍ Engines used for performance verification and testing ✍ Gas turbines ✍ Portable engines ✍ Natural gas-fired engines, when using other fuels during a natural gas curtailment, if operated no more than 336 hours per year on the other fuel ✍ Military tactical equipment ✍ Transportable engines ✍ Engines rated at 50 bhp or fewer
Administrative Requirements	✍ Emissions Control Plan required ✍ Maintain engine operating log
Monitoring Period	✍ For engines with external control devices, CEMS for NOx, CO, and O2, or alternate monitoring system ✍ For engines without external control devices, monitor operational characteristics as recommended by the manufacturer or emission control supplier ✍ Source test required every 24 months ✍ Annual testing of a representative sample of engines allowed for sites with multiple identical engines
Test Methods	NOx – EPA Method 7E or ARB Method 100 CO – EPA Method 10 or ARB Method 100 O2 – EPA Method 3 or 3A, or ARB Method 100 VOC – EPA Method 25 or 18, referenced as methane Bhp – Any method approved by the APCO and U.S. EPA

	Rule/Measure/Date
	San Luis Obispo County APCD **Rule 431** **11/13/1996**
Applicability	> 50 bhp
Limits	CO – 4500 ppmv @ 15% oxygen **Rich-Burn** NOx – 50 ppmv @ 15% oxygen or 90% reduction **Lean-Burn** NOx – 125 ppmv @ 15% oxygen or 80% reduction **Diesel** NOx -- 600 ppmv @ 15% oxygen or 30% reduction
Exemptions	✍ Agricultural operations ✍ ≤ 50 bhp engines ✍ Engines operating < 200 hours per year ✍ Emergency standby engines (maintenance limited to 50 hours per year) ✍ Research and teaching ✍ Test stands used for evaluating engine performance ✍ Diesel engines used to power cranes and welding equipment
Administrative Requirements	✍ Engine inspection plan required ✍ Inspection log required
Monitoring Period	Every 8,760 hours of operation or 3 years, whichever occurs first
Test Methods	NOx – ARB Method 100 CO – ARB Method 100

	Rule/Measure/Date
	Santa Barbara County APCD **Rule 333** **04/17/1997**
Applicability	Engines ? 50 bhp and requiring a permit
Limits	**Noncyclic Rich-Burn Engines** NOx – 50 ppmv @ 15% oxygen or 90% control ROC – 250 ppmv @ 15% oxygen CO – 4500 ppmv @ 15% oxygen **Noncyclic Lean-Burn Engines:** NOx – 125 ppmv @ 15% oxygen or 80% control ROC – 750 ppmv @ 15% oxygen CO – 4500 ppmv @ 15% oxygen **Cyclically-Operated Engines:** NOx – 50 ppmv @ 15% oxygen or 90% control ROC – 250 ppmv @ 15% oxygen CO – 4500 ppmv @ 15% oxygen **Diesel Engines:** NOx – 8.4 g/bhp-hr. or 797 ppmv @ 15% oxygen
Exemptions	✍ Engines operating on fuel consisting of 75% or more landfill gas ✍ Engines exempt from permit ✍ Engines operating fewer than 200 hours per year
Administrative Requirements	✍ Quarterly inspections with portable NOx monitor and inspection of engine operating parameters ✍ Bienniel source tests ✍ Annual source tests for two consecutive years if engine is non-compliant ✍ Engine operating log ✍ Compliance plan ✍ Engine inspection and maintenance plan
Monitoring Period	Every two years
Test Methods	NOx, CO, Oxygen – ARB Method 100 ROC – EPA Method 18 or 25 Fuel Composition – ASTM D-1945-81, ASTM D-3588-81, ASTM D-1072-80 Pollutant Emission Rate – EPA Method 19

	Rule/Measure/Date
	Shasta County AQMD **Rule 3.28** **04/01/1997**
Applicability	Any gaseous, diesel, or any other liquid-fueled stationary internal combustion engine within the borders of the District
Limits	*For engines > 50 bhp but ≤ 300 bhp:* CO – 4500 ppmv @ 15% oxygen **Rich-Burn** NOx – 640 ppmv @ 15% oxygen **Lean-Burn** NOx – 740 ppmv @ 15% oxygen **Diesel & all liquid-fired** NOx -- 600 ppmv @ 15% oxygen *For engines > 300 bhp:* CO – 4500 ppmv @ 15% oxygen **Rich-Burn** NOx – 90 ppmv @ 15% oxygen **Lean-Burn** 150 ppmv @ 15% oxygen **Diesel & all liquid-fueled** NOx – 600 ppmv @ 15% oxygen
Exemptions	✍ Agricultural operations ✍ Emergency standby engines operated < 200 hours/year ✍ Any engine rated by the manufacturer ≤ 50 bhp if maintained to manufacturers specifications ✍ Gas turbine engines ✍ Engines operated exclusively for fire fighting or flood control ✍ Laboratory engines operated in research and testing ✍ Existing IC engines to be permanently replaced with electric motors or removed from service by July 1, 1999 based upon a permit condition, contract, or binding agreement with the District ✍ Portable IC engines which have been registered and certified under the state portable equipment regulation ✍ Diesel IC engines manufactured prior to 1950 and operated less than 500 hours per year
Administrative Requirements	✍ Engine operating log for engines subject to emission limits
Monitoring Period	Annual source testing of emissions
Test Methods	NOx – EPA Method 7E or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer CO – EPA Method 10 or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer O2 – EPA Method 3 or 3A, or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer

	Rule/Measure/Date
	South Coast AQMD **Rule 1110.1** **10/04/1985**
Applicability	> 50 bhp, stationary, gaseous fueled engines only
Limits	**Rich-Burn** NOx – 90% reduction, initial test, 80% reduction thereafter, or 90 ppm at 15% oxygen CO – 2000 ppm at 15% oxygen **Lean-Burn** NOx/General – 80% reduction, initial test, 70% reduction thereafter, or 150 ppm at 15% oxygen NOx/Optional (combustion mods only) – 2 grams per bhp-hr.
Exemptions	✍ Agricultural operations ✍ Emergency standby engines which operate fewer than 200 hours per year ✍ Fire fighting and or flood control ✍ LPG-fueled ✍ Research and testing ✍ Performance verification and testing ✍ Engines operating in the Southeast Desert Air Basin portion of Los Angeles and Riverside Counties
Administrative Requirements	Control Plan
Monitoring Period	N/A
Test Methods	N/A

	Rule/Measure/Date
	South Coast AQMD **Rule 1110.2** **11/14/1997**
Applicability	> 50 bhp, stationary and portable engines
Limits	Permanently remove engine, replace engine with an electric motor, or reduce emissions to the following: **For stationary engines that generate electric power, are fired on landfill gas or sewage digester gas, are used for pumping water (except aeration facilities), are fueled by field gas, are integral engine compressors operating fewer than 4000 hours per year, or are LPG-fueled:** NOx – engines ≥ 500 bhp – 36 ppm @ 15% oxygen, engines > 50 and < 500 bhp – 45 ppm @ 15% oxygen VOC – 250 ppm @ 15% oxygen as methane CO – 2000 ppm @ 15% oxygen **For all other stationary engines:** NOx – 36 ppm @ 15% oxygen VOC – 250 ppm @ 15% oxygen as methane CO – 2000 ppm @ 15% oxygen **For portable engines:** Meet state limits equivalent to those in the State portable engine registration program
Exemptions	✍ Agricultural operations ✍ Emergency standby engines which operate fewer than 200 hours per year ✍ Fire fighting and or flood control ✍ Research and testing ✍ Performance verification and testing ✍ Engines locate in some parts of Riverside County ✍ Auxiliary engines used to power engines or gas turbines during start up
Administrative Requirements	✍ Engines > 1000 bhp and > 2 million bhp-hr. per year must use continuous emissions monitoring for NOx ✍ Monitoring system shall have data gathering and retrieval capability ✍ Operational and non-resettable totalizing time meter required ✍ Source testing of NOx, VOC, and CO every 3 years ✍ Maintain operating log
Monitoring Period	CEMS required for engines > 1000 bhp and > 2 million bhp-hr. per year Source test every three years
Test Methods	NOx – EPA Method 20 or District Method 100.1 CO – EPA Method 10 or District Method 100.1 VOC – EPA Method 25 or District Method 25.1

	Rule/Measure/Date
	Tehama County APCD **Rule 4.34** **06/03/1997**
Applicability	Any gaseous, diesel, or any other liquid-fueled stationary internal combustion engine within the borders of the District
Limits	*For engines > 50 bhp but ≤ 300 bhp:* CO – 4500 ppmv @ 15% oxygen **Rich-Burn** NOx – 640 ppmv @ 15% oxygen **Lean-Burn** NOx – 740 ppmv @ 15% oxygen **Diesel & all liquid-fired** NOx **--** 600 ppmv @ 15% oxygen *For engines > 300 bhp:* CO – 4500 ppmv @ 15% oxygen **Rich-Burn** NOx – 90 ppmv @ 15% oxygen **Lean-Burn** NOx – 150 ppmv @ 15% oxygen **Diesel & all liquid-fueled** NOx – 600 ppmv @ 15% oxygen
Exemptions	✍ Agricultural operations ✍ Emergency standby engines operated < 200 hours/year ✍ Any engine rated by the manufacturer ≤ 50 bhp if maintained to manufacturers specifications ✍ Gas turbine engines ✍ Engines operated exclusively for fire fighting or flood control ✍ Laboratory engines operated in research and testing ✍ Existing IC engines to be permanently replaced with electric motors or removed from service by July 1, 1999 based upon a permit condition, contract, or binding agreement with the District ✍ Portable IC engines which have been registered and certified under the state portable equipment regulation ✍ Diesel IC engines manufactured prior to 1950 and operated less than 500 hours per year
Administrative Requirements	✍ Engine operating log for engines subject to emission limits
Monitoring Period	Annual source testing of emissions
Test Methods	NOx – EPA Method 7E or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer CO – EPA Method 10 or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer O2 – EPA Method 3 or 3A, or ARB Method 100, or a method approved in writing by the APCO using a portable analyzer

	Rule/Measure/Date
	Ventura County APCD **Rule 74.9** **11/14/2000**
Applicability	Gas-fired, LPG, or diesel-fueled stationary internal combustion engine ≥ 50 bhp, if such engines are not used in oil field drilling operations
Limits	CO – 4500 ppmv @ 15% oxygen Ammonia – 20 ppmv **Rich-Burn** NOx – 25 ppmv @ 15% oxygen or 96% control ROC – 250 ppmv @ 15% oxygen **Lean-Burn** NOx – 45 ppmv @ 15% oxygen or 94% control ROC – 750 ppmv @ 15% oxygen **Diesel** NOx – 80 ppmv @ 15% oxygen or 90% control ROC – 750 ppmv @ 15% oxygen **Rich-Burn, waste gas** NOx – 50 ppmv @ 15% oxygen ROC – 250 ppmv @ 15% oxygen **Lean-Burn, waste gas** NOx – 125 ppmv @ 15% oxygen ROC – 750 ppmv @ 15% oxygen
Exemptions	✍ Engines rated less than 50 bhp ✍ Engines operated less than 200 hours per year ✍ Emergency standby engines operated only during emergencies and for no more than 50 hours per year for maintenance purposes ✍ Engines used in research and teaching ✍ Engine test stands used for evaluating engine performance ✍ < 100 bhp emitting NOx ≤ 5 g/bhp-hr., used in cogeneration ✍ Diesel engines limited to 15% or less annual capacity factor ✍ Diesel engines used to power cranes and welding equipment ✍ Diesel engines operated on San Nicolas Island and Anacapa Island
Administrative Requirements	✍ Engine Operator Inspection Plan ✍ Inspection log ✍ Annual usage ✍ Annual source test
Monitoring Period	Annual source test
Test Methods	NOx, CO, Oxygen – ARB Method 100 ROC – EPA Method 18 or 25, reference to methane Heating value of fuel oil – ASTM D240-87 Heating value of gaseous fuels – ASTM D1826-77 Ammonia – BAAQMD Method ST-1B

	Rule/Measure/Date
	Yolo-Solano AQMD **Rule 2.32** **08/10/1994**
Applicability	> 50 bhp, operated on gaseous fuels, LPG, or diesel
Limits	CO – 2000 ppmv @ 15% oxygen **5/31/95 limits:** NOx – 9.5 gm/bhp-hr. or 640 ppmv @ 15% oxygen (rich-burn), 10.1 gm/bhp-hr. or 740 ppmv @ 15% oxygen (lean-burn), 9.6 gm/bhp-hr. or 700 ppmv @ 15% oxygen (diesel) **If 5/31/95 limits not met, then following limits apply by 5/31/97:** NOx – 90 ppmv @ 15% oxygen (rich-burn), 150 ppmv @ 15% oxygen (lean-burn), 600 ppmv @ 15% oxygen (diesel) **If 5/31/95 and 5/31/97 limits not met, engine must be removed by 5/15/99**
Exemptions	✍ Agricultural operations ✍ ≤ 50 bhp engines ✍ Engines operating < 200 hours per year ✍ Emergency standby engines (maintenance limited to 50 hours/year) ✍ Research and teaching ✍ Test stands used for evaluating engine performance ✍ Diesel engines with permitted capacity < 15% ✍ Diesel engines used to power cranes and welding equipment
Administrative Requirements	✍ Engine operator inspection plan required ✍ Inspection log required
Monitoring Period	Annual source test
Test Methods	NOx – EPA Method 7E CO – EPA Method 10 O2 – EPA Method 3A Heating value of oil – ASTM Method D240-87 Heating value of gaseous fuel – ASTM Method D1826-77

APPENDIX D

EMISSIONS DATA

Following are tables summarizing emissions data for IC engines. Table D-1 summarizes data from the ARB Best Available Control Technology (BACT) Clearinghouse for IC engines. This Clearinghouse maintains a list of BACT determinations. These determinations are made for new or modified stationary sources with emissions increases above certain specified levels. Also included in this list are permit limits in cases where BACT was not required. Although these data are for new engines, in many cases existing engines can be retrofitted with the same technology with similar NOx reduction results.

Table D-2 summarizes source test data for IC engines from the Ventura County Air Pollution Control District. All engines were gas-fired. Following is an explanation of the meaning for each column in Table D-2:

MANUFACTURER - engine manufacturer
MODEL - engine model designated by the manufacturer
HORSEPOWER - maximum continuous brake horsepower rating of engine
R/L – an "r" signifies a rich-burn engine; an "l" signifies a lean-burn engine.
CONTROLS - description of controls on engine; "baseline" indicates the source test was a baseline test on an uncontrolled engine.
ST - status of engine; d = deleted, c = operational, m = electrified.
NOX IN - NOx emissions in parts per million by volume (ppmv) dry, corrected to 15 percent oxygen, before the exhaust control device. In some cases, for prestratified (PSC) engines, the "NOX IN" lists NOx emissions in ppmv with the PSC system turned off. If exhaust controls are not used, or emissions were only measured after the control device, this value is listed as "0".
NOX OUT - NOx emissions in ppmv dry, corrected to 15 percent oxygen, in the exhaust for engines not using exhaust controls, after the control device for engines using exhaust controls.
NOX REDUCED - the percentage reduction in NOx
CO OUT - carbon monoxide emissions in ppmv dry, in the exhaust for engines not using exhaust controls, after the control device for engines using exhaust controls.
NMHC PPM - nonmethane hydrocarbons in parts per million of carbon, dry, in the exhaust for engines not using exhaust controls, after the control device for engines usin
DATE TEST - date of the source test, month/day/year
O2% - oxygen concentration of the exhaust in percent
NMHC 15% O2 - nonmethane hydrocarbons in parts per million of carbon, dry, corrected to 15 percent oxygen, in the exhaust (after the control device for engines using exhaust controls).

CO 15% O2 - carbon monoxide emissions in ppmv dry, corrected to 15 percent oxygen, in the exhaust for engines not using exhaust controls, after the control device for engines using exhaust controls.

QST - exhaust flow rate in cubic feet per minute at standard conditions.

****** - value exceeds space allotted.

Table D-3 summarizes source test data from Santa Barbara County, while Table D-4 summarizes source test data from San Diego County. Table D-5 summarizes source test data from the San Joaquin Valley Unified APCD.

Equipment or Process: I.C. Engine - Landfill or Digester Gas Fired

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Minnesota Methane Tajiguas Corporation 4314 bhp Caterpillar model 3616 landfill gas-fired IC engine driving 3 MW electric generator with exhaust routed through afterburner/standby flare	1/9/98 (A/C no. 9788) A330-846-98 District Contact: Steve Sterner Santa Barbara County APCD (805) 961-8886 sterners@sbcapcd.org	Lean-burn IC engine, equipped with spark/torch ignition controls, fuel/air ratio controls and an intake air turbocharger and intercooler. 0.24 g/bhp-hr (equivalent to 20 ppmvd @ 3% O2 as Hexane)	Lean-burn IC engine, equipped with spark/torch ignition controls, fuel/air ratio controls and an intake air turbocharger and intercooler. 92 ppmvd at 3% oxygen 0.59 g/bhp-hr (Equivalent to 92 ppmvd at 3% oxygen)			Fuel pretreatment system to remove gas condensate and filter gas of particulates 0.34 g/bhp-hr (equivalent to 0.053 g/dscf & 0.073 lb/MMbtu)
Monterey Bay Regional Waste Management District 1274 hp Jenbacher model JGS 320 GS-LL IC engine fired on landfill gas	11/4/96 (A/C no. 8521 and 8522) A330-760-97 District Contact: Jerry Steele Monterey Bay Unified APCD (408) 647-9411		Lean-burn combustion technology 1.2 g/bhp-hr 213.45 lbm/day for three engines			

Equipment or Process: I.C. Engine - Landfill or Digester Gas Fired (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
City of Stockton Muncipal Utilities Dept. Regional Waste Water Control Facility 2760 bhp Waukesha model 12V-AT27GL IC engine fired on natural gas, digester gas, or a combination thereof	11/22/96 (A/C no. N-811-15-0) A330-725-96 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	Lean-burn engine with a precombustion chamber 0.75 g/bhp-hr 109.5 lbm/day	Lean-burn engine with a precombustion chamber 1.25 g/bhp-hr 182.5 lbm/day	Chemical addition to the digester sludge to reduce the influent fuel hydrogen sulfide content by 90% 0.1 g/bhp-hr 13.9 lbm/day (Hydrogen sulfide emissions shall be no more than 120 ppmv in digester gas)	Lean-burn engine with a precombustion chamber 2 g/bhp-hr 292.1 lbm/day	Digester gas or natural gas fuel or any blend of digester gas and natural gas 0.1 g/bhp-hr 14.6 lbm/day
Napa Sanitation District 913 hp Waukesha model 5900GL IC engine fired on digester gas with supplementary natural gas	3/26/93 (A/C no. 9006) A330-579-93 District Contact: Ted Hull Bay Area AQMD (415) 749-4919		Lean-burn combustion control 1.25 g/bhp-hr	Addition of iron salts to the digester sludge to reduce H2S concentrations of digester gas to less than 300 ppmv 0.30 g/bhp-hr		
Pacific Energy Otay Mesa Landfill 2650 hp Cooper-Superior model 16SGTA lean-burn engine-generator set with 1850 KW capacity	2/25/92 (A/C no. 891039) A330-545-92 District Contact: Bob Batten San Diego Co. APCD (619) 694-3316		Prechamber combustion and automatic air-to-fuel ratio controller 0.8 g/bhp-hr 4.7 lbm/hr			

Equipment or Process: I.C. Engine - Landfill or Digester Gas Fired (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
City of Ventura Wastewater Treatment Plant 773 bhp Waukesha F3521GL lean-burn reciprocating engine fired on digester or natural gas and producing 550 KW	12/31/86 (A/C no. 1377-1) A330-164-87 District Contact: Keith Duval Ventura Co. APCD (805) 654-2845 Kerby@vcapcd.org		Engine design 2 g/bhp-hr			
Poppy Ridge Partners Two 865 hp Waukesha reciprocating engines fired on digester gas (cogeneration)	9/16/86 (A/C nos. 8501 thru 8504) A330-154-86 District Contact: Aleta Kennard Sacramento Metropolitan AQMD (916) 366-2107		Pre-stratified charge emission control system 2.0 g/bhp-hr			
SF Southeast Treatment Plant 7300 hp reciprocating engine fired on sewage sludge gas (cogeneration)	5/86 (A/C no. 30456) A330-150-86 District Contact: Steve Hill Bay Area AQMD (415) 771-6000		Clean-burn engine 2.0 g/bhp-hr			

Equipment or Process: I.C. Engine - Landfill or Digester Gas Fired (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Genstar Gas Recovery Systems Two 2650 hp Cooper-Superior lean-burn IC engines fired on landfill gas	12/2/85 (A/C no. 30970) A330-109-86 District Contact: Craig Ullery Bay Area AQMD (415) 771-6000		Stratified charge combustion 1.5 g/hp-hr			
Genstar Gas Recovery Systems Two 1100 hp Cooper-Superior lean-burn IC engines fired on landfill gas	8/29/85 (A/C no. 30893) A330-108-86 District Contact: Craig Ullery Bay Area AQMD (415) 771-6000		Stratified charge combustion 1.5 g/hp-hr			

Equipment or Process: Spark Ignition, Natural Gas

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Kaiser Permanente Health Plan, Inc. 171 bhp four Tecodrive model 7400LE natural-gas spark-ignition engines use to drive two compressors/chillers that will provide cooling for the facility	12/14/99 (A/C No.: 362406) A310-963-00 District Contact: Roy Olivares South Cost AQMD (909) 396-2208 rolivares@aqmd.gov	Miratech model MN-11T-04F catalytic converter and Tecodrive air/fuel ratio controller 0.15 g/bhp-hr	Miratech model MN-11T-04F catalytic converter and Tecodrive air/fuel ratio controller 0.15 g/bhp-hr		Miratech model MN-11T-04F catalytic converter and Tecodrive air/fuel ratio Controller 0.60 g/bhp-hr	
Crestline Village Water District 93 bhp Ford model LSG875 natural gas-fired spark-ignition engine use to drive an electrical generator. Unit is used for backup generation, allowed to operate more than 200 hr/yr.	11/16/99 (A/C No.: 361525) A330-937-00 District Contact: Roy Olivares South Coast AQMD (909) 396-2208 roliveras@aqmd.gov	Miratech 3-way catalytic converter and air/fuel ratio controller 0.15 g/bhp-hr	Miratech 3-way catalytic converter and air/fuel ratio controller 0.15 g/bhp-hr		Miratech 3-way catalytic converter and air/fuel ratio controller 0.6 g/bhp-hr	
Orange County Flood Control District 750 bhp Waukesha model L5790G spark-ignition engine used to drive an emergency flood control pump	n.d. (A/C No.: 359876) A340-916-00 District Contact: Roy Olivare South Coast AQMD(909) 396-2208 rolivares@aqmd.gov	Miratech 3-way catalytic converter and air/fuel ratio controller 0.15 g/bhp-hr	Miratech 3-way catalytic converter and air/fuel ratio controller 0.15 g/bhp-hr		Miratech 3-way catalytic converter and air/fuel ratio controller 0.6 g/bhp-hr	

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Saba Petroleum, Inc./Bell Compressor Plant The engine is turbo-charged and inter-cooled and is configured in a rich burn mode. The compressor is rated at 3.073 MMSCFD.	10/12/98 (A/C no. 9975) A330-857-98 District Contact: Michael Goldman Santa Barbara County APCD (805) 961-8821 goldmanm@sbcapcd.org	3-way Catalytic Converter and Electric Air/Fuel Ratio Controller 0.30 g/bhp-hr 0.0766 lb/MMBtu/hr Voluntary information on controls. BACT not required.	3-way Catalytic Converter and Electric Air/Fuel Ratio Controller 0.15 g/bhp-hr 10 ppmvd @ 15% O2	Filed gas Total sulfur content not to exceed 239 ppmv Voluntary information on control. BACT not required	3-way Catalytic Converter and Electric Air/Fuel Ratio Controller 0.75 g/bhp-hr 83 ppmvd @ 15% O2 Voluntary information on controls. BACT not required.	
Kaiser Permanente Medical Center 160 bhp John Deere model 6076AFN30 natural gas-fueled clean-burn, IC engine limited to 1070 scf/hr gas usage	9/2/97 (A/C no. C-709-13-0) A330-783-97 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	Natural gas firing 150 @ 15% O2 (equivalent to 0.78 g/bhp-hr)	Natural gas firing 55 ppmv @ 15% (equivalent to 0.72 g/bhp-hr)		Natural gas firing 148 ppmv @ 15% O2 (equivalent to 1.24 g/bhp-hr)	

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Toys "R" Us 82 bhp Ford model no. LGC-649 natural-gas fired, rich-burn emergency IC engine driving a Kohler 39 KW electrical generator. Operation limited to emergency use and 200 hr/yr for testing and maintenance	11/27/96 (A/C no. C-2942-1-0) A330-763-97 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909		No control No limit (Expected emission level of 14.56 g/bhp-hr)		No control No limit (Expected emission level of 0.78 g/bhp-hr)	
City of Clovis 365 bhp, gas-fired Caterpillar model no. G3406TA rich-burn IC engine	11/8/96 (A/C no. C-2958-1-0) A330-762-97 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	Houston Industrial Silencing model DN/S-3656PH three-way catalyst and natural-gas firing 1.3 lbm/day (Equivalent to 0.068 g/bhp-hr or 30 ppmvd at 15% oxygen)	Houston Industrial Silencing model DN/S-3656PH three-way catalyst, oxygen controller, and natural-gas firing 0.33 g/bhp-hr (Equivalent to 25 ppmvd at 15% oxygen)	Natural gas firing 0.04 lbm/day (Equivalent to 0.60 lbm/MMscf)	Houston Industrial Silencing model DN/S-3656PH three-way catalyst, positive crankcase ventilation, oxygen controller, and natural-gas firing 10.8 lbm/day (Equivalent to 2.0 g/bhp-hr or 70 ppmvd at 15% oxygen)	Natural gas firing and positive crankcase ventilation 4.4 lbm/day (Equivalent to 0.23 g/bhp-hr)

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Vintage Petroleum Company Clark Avenue Oil and Gas Production Facility Thirteen 117 to 186 bhp, natural-gas Waukesha engines used to power oil wellhead pumping units and produced water pumps. Natural gas heat content from 900 to 1200 btu/scf.	2/4/97 (A/C no. 9682) A330-759-97 District Contact: Steve Sterner Santa Barbara Co. APCD (805) 961-8886 sterners@sbcapcd.org	Johnson-Matthey model MX-10 non-selective catalyst; Blackhawk Services fuel/air ratio controller; and positive crankcase ventilation 73 ppmv at 15% oxygen			Johnson-Matthey model MX-10 non-selective catalyst; Blackhawk Services fuel/air ratio controller; and positive crankcase ventilation 215 ppmv at 15% oxygen	
Gill's Onions Six 130 hp rich-burn, natural gas-fired, Caterpillar model 3306, TA internal combustion engines	5/18/95 (A/C no. 7018-110) A330-645-95 District Contact: Kerby Zozula Ventura County APCD (805) 645-1421 Kerby@vcapcd.org	Houston Industrial model DN/S 1004PC DeNOx Silencer three-way catalyst 103 ppmvd at 15% oxygen (Equivalent to 0.60 g/bhp-hr)	Houston Industrial model DN/S 1004PC DeNOx Silencer three-way catalyst 9 ppmvd at 15% oxygen (Equivalent to 0.15 g/bhp-hr)			

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Western Municipal Water District 525 hp, rich-burn Caterpillar model no. 3512 reciprocating engine fired on natural gas; LPG firing allowed during natural gas curtailment	6/1/91 (App. no. 223469) A330-453-90 District Contact: Permit Services South Coast AQMD (909) 396-3385		Nonselective catalytic reduction 1.5 g/bhp/hr 23 lbm/day			
Western Municipal Water District 525 hp, rich-burn Caterpillar model no. 3512 reciprocating engine fired on natural gas; LPG firing allowed during natural gas curtailment	6/1/91 (App. no. 223467) A330-452-90 District Contact: Permit Services South Coast AQMD (909) 396-3385		Nonselective catalytic reduction 1.5 g/bhp/hr 23 lbm/day			
Western Municipal Water District 525 hp, rich-burn Caterpillar model no. 3512 reciprocating engine fired on natural gas; LPG firing allowed during natural gas curtailment	6/1/91 (App. no. 223464) A330-451-90 District Contact: Permit Services South Coast AQMD (909) 396-3385		Nonselective catalytic reduction 1.5 g/bhp/hr 23 lbm/day			

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Exxon San Joaquin Production Co. Compressors driven by four 525 hp, naturally aspirated, gas-fired Caterpillar Model No. G-398 reciprocating engines at a natural gas processing plant	4/25/88 (A/C nos. 2066012 thru 2066015) A350-281-88 District Contact: Tom Goff Kern Co. APCD (now the San Joaquin Valley Unified APCD) (805) 862-5200		Three-way non-selective catalyst with air fuel ratio controller 1.0 g/bhp-hr 27.84 lbm/day/unit			
San Diego Marriott Hotel-Tower 1 1150 hp Caterpillar low-emission Model 3516TA lean-burn gas engine with 800 KW generator and waste-heat recovery (cogeneration)	3/9/87 (A/C no. 850810) A330-279-88 District Contact: Bob Batten San Diego Co. APCD (619) 694-3316		Lean-burn technology 1.4 g/bhp-hr 280 ppmvd at 3% oxygen			
California Dept. of Corrections, Corcoran Prison Two gas-fired, lean-burn Alco Model 12V-251-SI reciprocating engine-generator sets with total rated input of 31.46 MMBtu/hr and output of 3 MW and 540,000 lbm/hr hot water (cogeneration)	12/18/87 (A/C nos. 7815C and 7815D) A330-276-88 District Contact: George Heinen Kings Co. APCD (now the San Joaquin Valley Unified APCD) (559) 230-5909		Lean-burn torch ignition system incorporated in engine design 0.75 g/bhp-hr 0.22 lbm/MMBtu			

Equipment or Process: Spark Ignition, Natural Gas (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Shell California Production, Inc. 600 hp gas-fired Clark model HRA-6 IC lean-burn engine	11/14/84 (App. no. 147853) A330-208-87 District Contact: Permit Services South Coast AQMD (909) 396-3385		Selective catalytic reduction 100 lbm/day 70% control			
Tri County Sun Energy Sheraton Hotel 195 bhp Caterpillar Model No. G3306-TA reciprocating engine producing 130 KW	8/7/86 (A/C no. 1369-1) A330-165-87 District Contact: Keith Duval Ventura Co. APCD (805) 654-2845 Kerby@vcapcd.org		Nonselective catalytic reduction 50 ppmvd at 15% oxygen			
Shell California Production, Inc. 225 hp Caterpillar model no. G342 reciprocating engine used as a vapor recovery compressor	12/2/85 (A/C no. 0041-6) A330-107-86 District Contact: Keith Duval Ventura Co. APCD (805) 654-2045 Kerby@vcapcd.org		Nonselective catalytic reduction Least restrictive of 90% control, 50 ppmvd or 0.805 g/hp-hr			

Equipment or Process: Spark Ignition, Alternative Fuels

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Disneyland Resort 193 hp Ford model LSG-875R-6003-C gasoline-fired spark-ignition engine use to drive an emergency fire pump. Limited to 200 hr/ yr of operation.	10/21/99 (P/O No.: F22234 (no authority to construct issued - exempt standby unit)) A330-929-00 District Contact: Roy Olvares South Coast AQMD (909) 396-2208 rolivares@aqmd.gov	Two banks of Carsound Exhaust Systems, Inc. 3-way catalytic converters (model no. 298035) and an air/fuel ratio controller (model KAT2000) 0.15 g/bhp-hr	Two banks of Carsound Exhaust Systems, Inc. 3-way catalytic converters (model no. 298035) and an air/fuel ratio controller (model KAT2000) 0.15 g/bhp-hr		Two banks of Carsound Exhaust Systems, Inc. 3-way catalytic converters (model no. 298035) and an air/fuel ratio controller (model KAT2000) 0.6 g/bhp-hr	
Bakersfield Cellular Telephone Co. 72 hp Generac model 94A01244-s propane-fired emergency IC engine driving electrical generator	7/20/95 (A/C no. S-2836-1-0) A330-663-95 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909		Three-way catalyst No limit (Equivalent to 80% control efficiency)			
Western Environmental Engineers Company Petroleum tank degassing operation using two 175 hp Ford LSG-875 gas-fired IC engines fired on tank vapors with LPG auxiliary fuel	5/2/95 (A/C no. S-2482-1-0) A350-642-95 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	Carsound two-stage, three-way catalyst and air fuel monitoring 100 ppmv at 15% oxygen (Equivalent to 95% control)	Carsound two-stage, three-way catalyst an air-fuel monitoring 50 ppmv at 15% oxygen (Equivalent to 90% control)	LPG as auxiliary fuel to tank vapors 0.08 lbm/MMBtu	Carsound two-stage, three-way catalyst and air-fuel monitoring 150 ppmv at 15% oxygen	LPG as auxiliary fuel to tank vapors 0.1 lbm/MMBtu

Equipment or Process: Spark Ignition, Alternative Fuels (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Kenneth Harper and Associates Propane-fired, Ford model DGU-90 6-cylinder, 300 cid IC engine used in underground tank degassing; unit is to be operated 8 to 10 hours/day	5/10/91 (App. no. 228999) A430-557-92 District Contact: John Yee South Coast AQMD (909) 396-2531	Oxidation catalyst 98.6% control efficiency				
Shell Pipeline Corporation 82 hp Cummins-Oman 45EM propane-fired IC engine driving emergency generator	11/15/91 (A/C no. 4048020) A330-501-91 District Contact: Tom Goff/ Glenn Stevens San Joaquin Valley Unified APCD (805) 862-5200	Three-way catalyst and blowby gas gas recirculation 10% control efficiency	Three-way catalyst 60% control efficiency	Low sulfur fuel No limit	Three-way catalyst 96% control efficiency	
De La Guerra Power, Inc. 380 hp General Motors 500 cubic inch IC engine fired on scrubbed casing gas limited to 110 hp output	11/12/91 (A/C no. 0249003) A330-490-91 District Contact: Tom Goff/ Glenn Stevens San Joaquin Valley Unified APCD (805) 862-5200	Three-way catalyst and crankcase blowby recirculation 70% control efficiency	Three-way catalyst 90% control efficiency		Three-way catalyst 70% control efficiency	

Equipment or Process: Spark Ignition, Alternative Fuels (cont.)

Project Name & Description	A/C Issue Date & ARB File No.	BACT AND CORRESPONDING EMISSION CONTROL LEVELS				
		VOC/HC	NOx	SOx	CO	PM/PM_{10}
Richmond Exploration Corporation 200 hp Waukesha IC engine fired on propane and natural gas used for nitrogen gas injection in tertiary oil recovery	11/12/91 (A/C no. 4232005) A330-486-91 District Contact: Tom Goff San Joaquin Valley Unified APCD (805) 862-5200	Houston Industrial Silencing three-way catalyst 0.44 lbm/hr	Houston Industrial Silencing three-way catalyst 0.66 lbm/hr 90 ppmvd at 15% oxygen			
Richmond Exploration Corporation 200 hp Waukesha propane fired engine used for gas injection in tertiary oil recovery and using natural gas backup fuel	10/24/91 (A/C no. 4232005) A330-486-91 District Contact: Tom Goff/ Lynard Scandura San Joaquin Valley Unified APCD (805) 862-5200	Houston Industrial Silencing three-way catalyst 0.44 lbm/hr	Houston Industrial Silencing three-way catalyst 0.66 lbm/hr 90 ppmvd at 15% oxygen			
American Cogenics of California, Inc. (El Roblar Ranch) Two 700 hp Caterpillar G398TAHC reciprocating engines each with Maxim/12 silencer and 464 kilowatt generators; engines use rich burn combustion of field gas limited to 300 ppm hydrogen sulfide	7/17/90 (A/C no. 8016) A330-440-90 District Contact: Sanjib Mukherji Santa Barbara Co. APCD (805) 961-8800		Nonselective catalytic reduction 50 ppmvd at 15% oxygen; 92% minimum 1.245 lbm/hr/unit (Equivalent to 0.79 g/bhp-hr)			

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F3521GL	773		waste&nat gas		0.000	24.000	0.000	481.000	229.000	6/3/1993	9.600	119.000	251.000	1995.000
Worthington	58-2	950	l	None		151.000	151.000	0.000	308.000	206.400	12/11/1986	11.100	124.261	185.429	0.000
		0				0.000	146.700	0.000	1.370	1611.850	1/22/1991	0.365	0.000	0.400	25.320
Waukesha	VRG 220	48	r			0.000	13.000	0.000	3447.000	29.000	4/19/1994	0.200	8.000	982.000	7.850
Worthington	58-2	1000	l	None		52.000	52.000	0.000	0.000	0.000	10/21/1987	0.000	0.000	0.000	0.000
Ford	LSG-875	150				0.000	1.000	0.000	373.000	4.900	6/23/1994	0.100	1.400	105.000	250.000
Waukesha	VRG 220U	48	r	NSCR		0.000	1.000	0.000	3002.000	1.000	3/12/1992	0.010	1.000	847.000	45.000
Waukesha		74	r	None - ERC		339.000	339.000	0.000	2191.000	123.500	9/10/1987	0.280	35.337	631.000	96.460
Worthington	58-2	950	l	None		151.000	151.000	0.000	339.000	291.200	12/11/1986	11.500	182.774	212.777	0.000
Waukesha		74	r	None - ERC		247.000	247.000	0.000	2665.000	201.000	9/10/1987	0.510	58.161	776.000	97.070
White	G-8258	625	r	Engelhard Deoxo		572.000	5.000	99.100	6000.000	258.000	12/17/1982	0.010	72.867	1694.591	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44		758.000	3.000	99.600	9990.000	20.800	11/24/1986	0.100	5.900	2833.702	0.000
White	G-8258	625	r	Engelhard Deoxo		0.000	0.000	0.000	210.000	165.000	12/17/1982	0.200	47.029	59.855	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44		519.000	4.000	99.200	9053.000	22.500	11/24/1986	0.200	6.413	2580.324	0.000
Worthington	58-2	1000	l	None		136.000	136.000	0.000	0.000	0.000	10/20/1987	0.000	0.000	0.000	0.000
Worthington	58-2	1000	l	None		425.000	425.000	0.000	410.000	166.100	12/11/1986	9.600	86.725	214.071	0.000
White	G-8258	625	r	Engelhard Deoxo		2.000	2.000	0.000	11300.000	270.000	12/17/1982	0.010	76.257	3191.479	0.000
Worthington	58-2	1000	l	None		195.000	195.000	0.000	331.000	81.900	12/12/1986	11.000	48.809	197.263	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv		565.000	4.000	99.300	0.000	0.000	10/22/1987	0.000	0.000	0.000	0.000
Ingersoll-Rand	XVG-8	300	r	catalyst		311.000	3.000	99.000	28400.000	17.000	12/31/1985	0.100	4.822	8055.769	0.000
Waukesha	F1197GU	150	r	JM Denox	c	0.000	12.000	0.000	1133.000	0.000	7/29/1993	0.800	50.200	333.000	26.000
		38				0.000	289.000	0.000	0.350	619.000	1/17/1991	2.450	0.000	0.100	7.600
Ingersoll-Rand	SVG-12	660	r	EngelhardTorvex		449.000	3.000	99.300	4050.000	357.000	2/9/1982	0.050	101.022	1146.043	0.000
Waukesha		74	r	None - ERC		189.000	189.000	0.000	2183.000	318.000	9/10/1987	0.470	91.836	634.000	96.780
Waukesha	VRG 220	48	r	None		0.000	32.000	0.000	7452.000	810.000	8/6/1993	0.010	229.000	2105.000	5.000
Waukesha	145GZ	90				0.000	2.000	0.000	44935.000	7020.000	9/1/1988	11.500	0.000	0.000	218.000
Waukesha	VRG 220	48	r	None		0.000	9.000	0.000	8225.000	130.000	8/6/1993	3.900	45.000	2855.000	5.000
Waukesha	VRG 220	48	r	None		0.000	4.000	0.000	4673.000	117.000	8/6/1993	2.200	37.000	1474.000	4.000
Ingersoll-Rand	SVG-12	660	r	EngelhardTorvex		315.000	8.000	97.500	20915.000	22.400	12/12/1986	0.100	6.354	5932.620	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44		461.000	4.000	99.100	13414.000	18.000	12/1/1986	0.100	5.106	3804.933	0.000
Worthington	58-2	1000	l	None		96.000	96.000	0.000	0.000	0.000	10/20/1987	0.000	0.000	0.000	0.000
Waukesha	VRG 220	25	r	Catalyst		29.000	1.000	97.500	13313.000	248.000	2/23/1990	0.100	70.000	3776.000	14.000
Waukesha	VRG 220	48	r			0.000	42.000	0.000	1.000	266.000	8/1/1994	6.400	108.000	1.000	34.330
Waukesha	VRG 220	48	r			0.000	25.000	0.000	1.000	138.000	8/25/1994	6.200	55.000	1.000	10.300
Continental	F226	30				234.400	0.000	0.000	0.000	0.000	12/16/1986	3.380	0.000	0.000	100.800
Continental	F226	30				424.100	0.000	0.000	0.000	0.000	12/15/1986	3.160	0.000	0.000	91.200
Continental	F226	30				128.200	0.000	0.000	0.000	0.000	12/15/1986	2.950	0.000	0.000	93.510

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
		38				0.000	154.000	0.000	2.920	45.000	1/17/1991	7.080	0.000	1.250	17.810
Continental	F226	30				438.700	0.000	0.000	0.000	0.000	12/16/1986	4.560	0.000	0.000	73.800
Ford	LSG-875	150				0.000	6.000	0.000	1.000	32.500	6/23/1994	0.100	9.200	1.000	245.000
Waukesha	VRG 220	48	r			0.000	6.000	0.000	5997.000	154.000	6/6/1994	0.200	44.000	1709.000	9.000
Waukesha	VRG 220	48	r			0.000	8.000	0.000	630.000	307.000	6/6/1994	11.800	199.000	408.000	11.820
Continental	F226	30				276.100	0.000	0.000	0.000	0.000	12/16/1986	4.810	0.000	0.000	57.600
		0				0.000	25.600	0.000	1.600	1445.000	1/22/1991	5.745	0.000	0.650	42.660
Continental	F226	30				550.000	0.000	0.000	0.000	0.000	12/15/1986	3.200	0.000	0.000	67.200
		0				0.000	6.000	0.000	289.330	1032.550	1/22/1991	15.950	0.000	345.350	116.220
Ford	GSG-649	126	r	Auto Catalyst		0.000	6.000	0.000	20.000	28.000	9/15/1992	2.700	9.000	7.000	97.000
Continental	F226	30				242.800	0.000	0.000	0.000	0.000	12/16/1986	3.010	0.000	0.000	70.200
Ingersoll-Rand	SVG-12	660	r	NSCR		438.300	131.300	70.000	13000.000	3800.000	6/4/1986	0.500	3800.000	3769.000	0.000
		0				0.000	93.650	0.000	301.600	30.050	1/22/1991	14.540	0.000	242.450	70.060
Waukesha	F1197GU	150	r	Englehard NSCR		0.000	11.000	0.000	300.000	284.000	6/4/1992	0.100	80.000	127.000	38.000
Ford	GSG-649	126	r	Auto Catalyst		0.000	19.000	0.000	29.000	27.000	9/15/1992	3.400	9.000	10.000	100.000
Waukesha	L5790GU	748	r	NSCR	c	0.000	5.800	0.000	8006.100	30.900	7/10/1997	0.210	8.800	2283.600	1133.000
Ford	460V8	108	r	NSCR	c	0.000	10.000	0.000	2806.000	103.000	1/23/1997	0.010	29.000	793.000	110.000
Waukesha	L7042G-	585	r	NSCR Englehard		0.000	8.000	0.000	5839.000	169.000	10/26/1995	1.100	50.000	1740.000	594.000
Waukesha	L7042G-	585	r	NSCR Englehard		0.000	9.000	0.000	6024.000	94.000	10/26/1995	0.100	27.000	1707.000	585.000
		325	r		c	0.000	5.700	0.000	2766.500	295.600	4/11/1997	0.255	84.500	790.700	665.300
Waukesha	L7042G-	585	r	NSCR Englehard		0.000	18.000	0.000	6974.000	168.000	10/26/1995	0.200	48.000	1986.000	547.000
Caterpillar	G-379-A	295	r	NSCR	c	0.000	2.000	0.000	2928.000	108.000	11/26/1996	0.010	31.000	827.000	381.000
Waukesha	VRG 220	80				0.000	43.400	0.000	1.000	199.000	10/12/1995	6.700	83.000	0.400	7.250
Waukesha	VRG 220	80				0.000	29.600	0.000	4.000	226.000	10/12/1995	4.700	82.000	1.500	6.470
Waukesha	VRG 220	80				0.000	28.100	0.000	7.000	87.000	9/19/1995	3.800	30.000	2.400	4.000
Tecogen	CM-60	89	r	NSCR	c	0.000	3.000	0.000	4054.000	19.000	11/13/1996	0.100	5.000	1150.000	113.000
Waukesha	VRG 220	80				0.000	31.300	0.000	1.700	356.000	9/19/1995	6.500	146.000	0.700	4.890
Ford	460V8	108	r	NSCR	c	0.000	10.000	0.000	2332.000	8.200	1/23/1997	0.010	2.300	659.000	110.000
Caterpillar	G-3306TA	194	r	NSCR		0.000	6.000	0.000	5041.000	80.000	3/12/1997	0.010	23.000	1423.000	225.000
White	G-8258	625	r	NSCR		0.000	7.200	0.000	6077.400	3.400	7/29/1997	0.250	1.000	1736.800	699.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	52.000	0.000	226.000	1120.000	11/26/1996	13.400	881.000	178.000	490.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	34.000	0.000	185.000	558.000	11/26/1996	14.400	506.000	168.000	548.000
Caterpillar	G-3408	375	r	NSCR		0.000	6.580	0.000	2037.000	0.000	5/15/1997	0.060	31.100	577.000	2442.000
Waukesha	L5790GV	738	r	NSCR	c	0.000	5.700	0.000	2856.400	0.000	7/10/1997	0.110	0.000	810.500	353.000
		48		None		0.000	16.700	0.000	5.500	51.900	3/26/1997	7.020	22.100	2.300	0.000
		48		None		0.000	12.900	0.000	51.800	362.600	3/26/1997	10.300	179.800	28.800	0.000
Ingersoll-Rand	JVG-8	225	r	NSCR - ECS		0.000	9.000	0.000	649.000	60.000	5/5/1996	0.010	17.000	183.000	245.000

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
		48		None		0.000	17.600	0.000	41.700	157.900	3/26/1997	7.010	67.100	17.700	0.000
Continental	F226	30				281.500	0.000	0.000	0.000	0.000	12/16/1986	4.090	0.000	0.000	117.000
Waukesha	F3521GC	773				0.000	88.000	0.000	542.000	0.000	8/8/1996	8.900	0.000	266.000	2282.000
Enterprise	GSG-6	465	r	NSCR	c	0.000	15.000	0.000	13532.000	0.000	3/14/1997	0.100	0.000	3838.000	0.000
		48		None		0.000	18.600	0.000	129.300	101.900	3/26/1997	6.700	42.300	53.700	0.000
White	G-8258	625	r	NSCR		0.000	10.800	0.000	8947.200	6.300	7/29/1997	0.350	1.800	2568.400	717.000
		48		None		0.000	42.100	0.000	1559.700	77.800	3/26/1997	4.180	27.500	550.400	0.000
Caterpillar	G-3408	375	r	NSCR		0.000	7.880	0.000	2857.000	0.000	5/15/1997	0.750	26.800	836.000	2694.000
		48		None		0.000	11.500	0.000	33.800	394.200	3/26/1997	8.650	189.800	16.300	0.000
		48		None		0.000	15.300	0.000	283.200	283.100	3/26/1997	8.890	129.500	139.200	0.000
		48		None		0.000	9.200	0.000	159.200	128.200	3/26/1997	12.090	43.200	106.600	0.000
Waukesha	145GZ	90				0.000	6.000	0.000	50000.000	774.000	9/1/1988	1.300	0.000	0.000	74.000
Continental	F226	30				46.800	0.000	0.000	0.000	0.000	12/16/1986	6.760	0.000	0.000	85.200
Continental	F226	30				233.200	0.000	0.000	0.000	0.000	12/16/1986	9.160	0.000	0.000	112.800
Ford	460V8	108	r	NSCR	c	0.000	10.000	0.000	3857.000	2.100	1/23/1997	0.010	0.600	1090.000	110.000
Waukesha	VRG 220	80				0.000	32.700	0.000	16.000	355.000	10/12/1995	6.800	149.000	6.700	6.900
Waukesha		725			c	0.000	2.300	0.000	722.400	27.000	3/8/1997	0.020	7.600	204.100	0.000
Caterpillar	G-3306TA	194	r	NSCR (?)	c	0.000	5.000	0.000	2096.000	4.200	11/18/1997	0.010	1.200	592.000	238.000
Caterpillar	G-379-A	295	r	NSCR		0.000	23.000	0.000	4456.000	169.000	11/29/1995	0.200	48.000	1270.000	207.000
Caterpillar	G-342	235	l	None	m	0.000	356.000	0.000	0.000	406.000	1/31/1991	0.500	0.000	0.000	167.480
Ingersoll-Rand	JVG-6	165	r	HoustonInd Cat	c	457.000	29.000	93.700	7358.000	100.000	3/4/1988	0.010	28.365	2087.125	163.000
Ingersoll-Rand	JVG-6	165	r	Houston Cat		0.000	22.500	0.000	4266.000	103.000	11/4/1993	0.004	29.100	1204.000	178.000
Ingersoll-Rand	JVG-6	165	r	NSCR		0.000	26.700	0.000	9527.000	204.000	9/26/1991	0.030	54.500	2692.000	0.000
Ingersoll-Rand	JVG-8	225	r	NSCR		0.000	12.400	0.000	563.000	186.000	9/26/1991	0.020	48.600	160.000	0.000
Ingersoll-Rand	JVG-8	225	r	NSCR	c	709.000	14.000	98.000	3350.000	270.000	1/29/1992	0.100	80.000	950.000	302.000
Ingersoll-Rand	JVG-6	165	r	NSCR	c	391.000	17.000	95.700	2050.000	130.000	1/29/1992	0.100	40.000	600.000	177.000
Ingersoll-Rand	JVG-6	165	r	NSCR Houston		0.000	8.110	0.000	1494.000	59.000	11/30/1994	0.010	17.000	422.000	185.000
Ingersoll-Rand	JVG-8	225	r	NSCR	c	0.000	12.200	0.000	2440.000	244.000	8/11/1992	0.340	60.000	676.000	244.000
Ingersoll-Rand	JVG-6	165	r	NSCR	c	0.000	7.090	0.000	1088.000	89.000	8/11/1992	0.400	26.000	313.000	167.000
Ingersoll-Rand	JVG-6	165	r	NSCR		0.000	8.000	0.000	4039.000	101.000	11/29/1995	0.010	28.000	1140.000	167.000
Ingersoll-Rand	JVG-8	225	r	HoustonInd Cat	c	564.000	32.000	94.300	8613.000	84.000	12/10/1987	0.010	23.942	2454.913	273.000
Ingersoll-Rand	JVG-8	225	r	Houston Cat		0.000	14.700	0.000	1778.000	108.000	11/4/1993	0.056	30.400	503.000	283.000
Ingersoll-Rand	JVG-8	225	r	NSCR		591.000	38.000	93.500	0.000	0.000	6/5/1986	0.010	0.000	0.000	0.000
Ingersoll-Rand	JVG-8	225	r	NSCR Houston		0.000	10.700	0.000	2097.000	72.000	11/30/1994	0.120	20.000	595.000	185.000
Ingersoll-Rand	JVG-8	225	r	NSCR Houston		0.000	10.700	0.000	2097.000	72.000	6/7/1994	0.120	20.000	595.000	185.000
White	G-8258	750	r	ECS NSCR		0.000	39.100	0.000	11383.000	225.000	11/4/1993	0.020	63.600	3217.000	777.000
White	G-8258	750	r	NSCR ESC		0.000	51.800	0.000	0.000	0.000	6/7/1994	0.010	0.000	1901.000	771.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
White	G-8258	750	r	ECS NSCR	c	0.000	31.600	0.000	7320.000	109.000	8/11/1992	0.290	31.000	2139.000	730.000
White	G-8258	750	r	ECS NSCR	c	643.000	60.000	90.700	1750.000	90.000	1/29/1992	0.100	30.000	500.000	737.000
White	G-8258	750	r	NSCR		509.000	50.500	90.100	1960.000	121.000	9/26/1991	3.000	34.000	554.000	0.000
White	G-8258	750	r	NSCR		1921.000	61.000	0.000	4000.000	46.200	2/14/1986	0.300	0.000	0.000	670.000
White	G-8258	750	r	NSCR	c	0.000	0.800	0.000	2305.000	1.400	11/18/1997	0.010	0.400	651.000	656.000
White	G-8258	750	r	NSCR - ECS		0.000	25.000	0.000	4577.000	91.000	11/29/1995	0.010	26.000	1292.000	685.000
White	G-8258	750	r	NSCR - ECS	c	0.000	0.300	0.000	977.000	185.000	11/26/1996	0.010	52.000	276.000	925.000
Ingersoll-Rand	XVG-4	150	r	NSCR	c	359.000	26.000	92.600	8264.000	135.000	8/31/1990	0.100	38.000	2333.000	169.000
Caterpillar	G-379-A	295	r	Houston Ind CC	c	786.000	31.000	96.100	3686.000	184.000	12/10/1987	0.010	52.956	1060.849	224.000
Caterpillar	G-379-A	295	r	NSCR		0.000	38.800	0.000	2220.000	100.000	11/30/1994	0.050	29.000	628.000	180.000
Caterpillar	G-379-A	295	r	NSCR		878.000	62.000	92.900	422.000	344.000	9/26/1991	0.120	56.000	120.000	0.000
Caterpillar	G-379-A	295	r			0.000	39.100	0.000	3049.000	129.000	11/4/1993	0.020	36.400	861.000	246.000
Caterpillar	G-379-A	295	r	NSCR	c	0.000	15.000	0.000	4966.000	25.000	11/18/1997	0.010	7.000	1402.000	264.000
Ajax	DP-115	115				0.000	12.000	0.000	192.000	2053.000	10/30/1987	13.500	0.000	0.000	554.000
Ajax	DP-115	115				441.000	0.000	0.000	1113.000	1114.000	10/30/1987	15.600	0.000	0.000	607.000
Ajax	DP-115	115				399.000	0.000	0.000	345.000	304.000	10/30/1987	18.100	0.000	0.000	1320.000
Minnepls-Moline	HUA	97	r	None	d	0.000	101.000	0.000	34816.000	133.000	12/22/1987	3.600	0.000	0.000	48.000
Minnepls-Moline	605A	113	r	None	d	0.000	542.000	0.000	8894.000	149.000	12/22/1987	0.700	0.000	0.000	42.000
Caterpillar	G-3306	67	r	NSCR		0.000	1.000	0.000	9739.000	45.000	12/20/1991	0.100	13.000	2749.000	135.000
Caterpillar	G-3306	67	r	R-B NSCR	c	393.000	23.000	94.100	18477.000	76.000	12/11/1989	0.100	22.000	5229.000	193.000
Waukesha	F3521GU	391	r	NSCR		0.000	5.000	0.000	1324.000	33.000	5/17/1994	0.200	12.000	377.000	254.000
Waukesha	F3521GU	391	r	NSCR		0.000	5.000	0.000	212.000	7.800	11/30/1994	0.100	2.200	60.000	510.000
Waukesha	F3521GU	391	r	R-B SCR		215.400	4.200	0.000	0.000	0.000	9/23/1993	0.300	105.300	8833.300	576.000
Waukesha	F3521GU	391	r	R-B NSCR	c	174.000	4.000	97.900	39107.000	106.000	12/11/1989	0.010	30.000	11040.000	585.000
Waukesha	F3521GU	391	r	R-B NSCR	c	495.000	22.000	95.500	11992.000	82.000	6/11/1990	0.100	23.000	3401.000	528.000
Waukesha	F3521GU	375	r	NSCR	c	0.000	7.000	0.000	224.000	4.200	3/7/1997	1.600	1.300	68.000	555.000
Minnepls-Moline	605-HUA	117	r		d	149.500	0.000	0.000	10333.500	0.000	10/27/1988	1.650	0.000	0.000	2340.000
Waukesha	145	195	r		d	338.000	0.000	0.000	10240.500	0.000	10/27/1988	3.000	0.000	0.000	3507.000
Waukesha	145	195	r		d	340.000	0.000	0.000	10655.000	0.000	10/27/1988	1.050	0.000	0.000	964.500
Waukesha	140GZ	116	r	PSC	d	840.000	24.000	97.100	154.000	137.000	12/21/1986	9.100	68.500	77.000	0.000
Waukesha	140GZ	116	r	PSC		183.500	0.000	0.000	7257.500	0.000	10/28/1988	0.600	0.000	0.000	2166.500
Waukesha	140GZ	116	r	PSC		636.500	0.000	0.000	8262.000	0.000	10/28/1988	0.700	0.000	0.000	3236.500
Waukesha	140GZ	116	r	PSC		951.000	0.000	0.000	6179.500	0.000	10/24/1988	1.250	0.000	0.000	3240.000
Caterpillar	G-379	330	r	PSC		0.000	23.200	0.000	381.200	84.700	9/27/1994	8.500	40.300	181.500	0.000
Caterpillar	G-379	330	r	PSC		0.000	13.000	0.000	450.600	7.500	2/4/1991	9.290	3.700	228.800	563.012
Caterpillar	G-379	330	r	PSC		0.000	36.880	0.000	414.630	430.000	7/30/1992	8.480	204.270	196.990	292.192
Caterpillar	G-379	330	r	PSC		0.000	17.960	0.000	521.390	467.000	8/25/1993	9.080	233.000	260.260	299.232

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Caterpillar	G-379	330	r	PSC	c	0.000	24.000	0.000	292.000	85.300	6/27/1989	8.170	2.947	135.000	516.000
Caterpillar	G-379	330	r	PSC		0.000	31.400	0.000	355.000	265.000	9/14/1995	8.600	127.000	170.000	0.000
Caterpillar	G-379	330	r	PSC	c	954.000	63.000	93.400	388.000	27.500	12/12/1991	2.120	12.840	181.000	575.000
Caterpillar	G-379	330	r	NSCR	c	0.000	0.470	0.000	488.210	17.000	4/7/1997	0.040	4.840	138.900	538.300
Caterpillar	G-398	330	r	PSC		0.000	29.600	0.000	367.000	88.300	6/27/1996	8.400	41.700	174.000	0.000
Caterpillar	G-379	330	r	Baseline	c	898.000	898.000	0.000	349.000	104.900	6/19/1986	1.900	32.574	108.374	154.000
Caterpillar	G-379	330	r	PSC		0.000	14.010	0.000	390.140	235.000	8/25/1993	8.760	114.000	189.610	321.693
Caterpillar	G-379	330	r	PSC PreStrat Ch	c	44.000	44.000	0.000	396.000	208.900	11/24/1986	8.800	101.860	193.091	0.000
Caterpillar	G-379	330	r	PSC PreStrat Ch	c	0.000	14.000	0.000	466.000	113.500	3/23/1987	9.000	56.273	231.042	204.000
Caterpillar	G-379	330	r	PSC	c	0.000	42.000	0.000	370.000	122.500	6/27/1989	9.580	3.610	192.000	548.000
Caterpillar	G-379	330	r	PSC		0.000	21.100	0.000	405.200	104.700	9/27/1994	9.300	53.300	206.500	0.000
Caterpillar	G-379	330	r	PSC		0.000	29.230	0.000	442.670	376.670	7/30/1992	8.570	180.240	211.740	294.325
Caterpillar	G-379	330	r	PSC		0.000	25.600	0.000	342.000	325.000	9/14/1995	9.900	174.000	183.000	0.000
Caterpillar	G-379	330	r	PSC		0.000	31.300	0.000	450.400	290.000	2/4/1991	9.490	150.000	232.900	585.810
Caterpillar	G-379	330	r	PSC	c	0.000	30.000	0.000	361.000	0.000	10/13/1992	8.140	0.000	167.070	0.000
Caterpillar	G-379	330	r	NSCR	c	0.000	0.130	0.000	191.180	5.800	4/7/1997	0.160	1.660	54.720	541.400
Caterpillar	G-398	330	r	PSC		0.000	29.100	0.000	343.000	86.500	6/27/1996	8.000	39.600	157.000	0.000
Caterpillar	G-379	330	r	PSC		0.000	24.160	0.000	387.590	476.670	11/17/1992	8.650	229.580	186.640	312.000
Caterpillar	G-379	330	r	PSC PreStrat Ch	c	0.000	14.000	0.000	354.000	134.000	3/3/1988	8.300	62.746	165.762	192.000
Caterpillar	G-379	330	r	PSC PreStrat Ch	c	0.000	23.000	0.000	359.000	46.600	3/23/1987	8.600	22.353	172.203	197.000
Caterpillar	G-379	330	r	PSC		0.000	41.270	0.000	442.840	149.000	8/25/1993	10.110	81.000	242.160	338.893
Caterpillar	G-379	330	r	PSC	c	0.000	39.000	0.000	380.000	0.000	5/15/1990	8.400	0.000	179.000	199.000
Caterpillar	G-379	330	r	PSC	c	0.000	43.000	0.000	285.000	53.300	6/27/1989	8.790	1.712	139.000	516.000
Caterpillar	G-379	330	r	PSC		0.000	32.570	0.000	333.670	676.670	7/30/1992	8.650	325.000	160.640	296.247
Caterpillar	G-379	330	r	PSC		0.000	31.600	0.000	340.000	256.000	9/14/1995	8.500	122.000	162.000	0.000
Caterpillar	G-379	330	r	PSC		0.000	31.000	0.000	496.300	205.000	2/4/1991	10.190	115.300	273.400	627.380
Caterpillar	G-379	330	r	PSC	c	852.000	68.000	92.100	351.000	10.000	12/12/1991	1.310	4.450	156.000	410.000
Caterpillar	G-379	330	r	PSC		0.000	35.400	0.000	346.100	109.000	9/27/1994	8.500	51.900	165.300	0.000
Caterpillar	G-398	330	r	PSC		0.000	32.400	0.000	359.000	113.700	6/27/1996	8.600	54.500	173.000	0.000
Caterpillar	G-379	330	r	NSCR	c	0.000	0.100	0.000	462.010	12.900	4/7/1997	0.120	3.690	131.980	540.300
Caterpillar	G-398	500	r	PSC		0.000	28.820	0.000	506.500	536.000	8/25/1993	9.260	272.000	256.670	352.920
Caterpillar	G-398	500	r	PSC		0.000	29.300	0.000	406.800	155.300	9/26/1994	8.400	73.300	192.500	0.000
Caterpillar	G-398	500	r	PSC		0.000	25.670	0.000	467.920	366.670	7/30/1992	12.020	243.620	310.720	431.494
Caterpillar	G-398	500	r	PSC		0.000	45.700	0.000	388.000	299.000	9/14/1995	8.200	139.000	180.000	0.000
Caterpillar	G-398	500	r	NSCR	c	0.000	0.040	0.000	481.090	7.900	4/7/1997	0.020	2.250	136.770	831.700
Caterpillar	G-398	500	r	PSC		0.000	60.000	0.000	374.000	66.000	6/27/1996	7.800	29.700	168.000	0.000
Caterpillar	G-398	500	r	PSC	d	0.000	25.000	0.000	434.000	0.000	10/13/1992	8.500	0.000	206.690	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Caterpillar	G-398	500	r	PSC		0.000	14.260	0.000	402.320	224.000	8/25/1993	7.950	102.000	183.230	312.240
Caterpillar	G-398	500	r	PSC		0.000	39.000	0.000	397.100	198.200	9/27/1994	8.900	97.400	195.400	0.000
Caterpillar	G-398	500	r	PSC		0.000	26.270	0.000	473.170	98.000	7/30/1992	8.590	46.970	226.810	311.264
Caterpillar	G-398	500	r	PSC		0.000	31.800	0.000	357.000	212.000	9/14/1995	8.300	99.200	167.000	0.000
Caterpillar	G-398	500	r	PSC	d	0.000	29.000	0.000	384.000	0.000	10/13/1992	8.060	0.000	176.390	0.000
Caterpillar	G-398	500	r	NSCR	c	0.000	0.040	0.000	321.320	9.100	4/7/1997	0.030	2.590	91.390	832.100
Caterpillar	G-398	500	r	PSC		0.000	39.600	0.000	624.000	394.000	6/27/1996	9.000	116.000	308.000	0.000
Waukesha	P9390G	800	r	PSC		0.000	25.360	0.000	381.990	235.000	8/25/1993	7.590	104.000	169.260	786.761
Waukesha	P9390G	800	r	PSC PreStrat Ch	c	0.000	44.000	0.000	275.000	44.000	10/20/1987	6.700	18.282	114.261	1117.000
Waukesha	P9390G	800	r	PSC		0.000	30.100	0.000	280.800	36.500	2/4/1991	6.320	14.900	113.600	1086.830
Waukesha	P9390G	800	r	PSC		0.000	49.600	0.000	0.000	0.000	12/22/1993	9.400	211.000	210.600	1421.000
Waukesha	P9390G	800	r	PSC heat/cogen	c	0.000	43.000	0.000	190.000	173.700	6/27/1989	7.450	6.582	83.200	1042.000
Waukesha	P9390G	800	r	PSC heat/cogen	c	0.000	36.000	0.000	341.000	0.000	10/13/1992	6.920	0.000	144.110	0.000
Waukesha	P9390G	800	r	PSC		0.000	34.700	0.000	425.400	25.600	9/26/1994	7.500	11.300	187.100	0.000
Waukesha	P9390G	800	r	PSC		0.000	34.900	0.000	405.000	110.000	9/14/1995	7.200	47.200	174.000	0.000
Waukesha	P9390G	800	r	PSC		0.000	23.430	0.000	343.580	27.330	7/30/1992	6.740	11.390	143.160	722.757
Waukesha	P9390G	800	r	PSC	c	0.000	31.000	0.000	249.000	6.000	6/24/1997	6.800	2.500	104.000	2176.000
Waukesha	P9390G	800	r	PSC		0.000	33.700	0.000	424.000	26.100	6/27/1996	7.600	11.600	188.000	0.000
Waukesha	P9390G	800	r	PSC		0.000	36.500	0.000	381.060	84.000	8/25/1993	7.370	37.000	166.170	784.748
Waukesha	P9390G	800	r	PSC heat/cogen	c	0.000	19.000	0.000	209.000	41.000	6/27/1989	7.120	1.626	89.300	1145.000
Waukesha	P9390G	800	r	PSC		0.000	38.700	0.000	271.000	119.000	9/14/1995	7.500	52.600	120.000	0.000
Waukesha	P9390G	800	r	PSC heat/cogen	c	0.000	7.000	0.000	330.000	0.000	10/13/1992	8.630	0.000	158.760	0.000
Waukesha	P9390G	800	r	PSC		0.000	24.000	0.000	324.700	17.400	9/26/1994	7.400	7.600	141.600	0.000
Waukesha	P9390G	800	r	PSC		0.000	32.580	0.000	335.940	34.670	7/30/1992	7.190	14.920	144.520	746.480
Waukesha	P9390G	800	r	PSC		0.000	25.100	0.000	236.600	39.000	2/4/1991	6.580	16.200	97.500	1022.430
Waukesha	P9390G	800	r	PSC	c	0.000	28.000	0.000	249.000	5.900	6/24/1997	7.100	2.500	106.000	2223.000
Waukesha	P9390G	800	r	PSC		0.000	23.000	0.000	237.000	23.300	6/27/1996	7.300	10.100	103.000	0.000
Waukesha	P9390G	796	r	PSC PreStrat Ch	c	845.000	50.000	94.100	334.000	40.000	3/24/1987	6.900	16.857	140.757	915.000
Waukesha	P9390G	796	r	PSC AirEGR DGEC	c	0.000	39.000	0.000	323.000	43.000	12/29/1987	9.000	21.319	160.143	1140.000
Waukesha	P9390G	800	r	PSC heat/cogen	c	0.000	22.000	0.000	202.000	30.000	6/27/1989	6.770	1.251	84.300	992.000
Waukesha	P9390G	800	r	PSC Heat/Cogen	c	0.000	20.000	0.000	267.000	0.000	5/15/1990	7.500	0.000	118.000	2386.000
Waukesha	P9390G	800	r	PSC		0.000	47.200	0.000	241.900	16.400	9/26/1994	6.500	6.700	99.200	0.000
Waukesha	P9390G	800	r	PSC		0.000	695.000	0.000	409.000	0.000	5/31/1985	0.600	0.000	0.000	574.000
Waukesha	P9390G	800	r	PSC		0.000	29.030	0.000	334.970	23.670	7/30/1992	6.070	9.420	133.220	690.104
Waukesha	P9390G	800	r	PSC		0.000	27.660	0.000	353.290	70.000	8/25/1993	7.080	30.000	150.830	780.944
Waukesha	P9390G	800	r	PSC		0.000	38.600	0.000	249.000	66.500	9/14/1995	8.000	30.400	114.000	0.000
Waukesha	P9390G	800	r	PSC		0.000	25.400	0.000	246.800	41.500	2/4/1991	6.390	16.900	100.300	1050.510

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	P9390G	800	r	PSC	c	0.000	29.000	0.000	274.000	5.700	6/24/1997	6.600	2.400	113.000	2092.000
Caterpillar	G-353	250	r			0.000	29.000	0.000	208.000	0.000	4/28/1992	2.000	3.000	63.000	169.000
Caterpillar	G-353	250	r	JM Cat Convertr		0.000	4.000	0.000	4356.000	30.000	8/13/1993	0.100	8.000	1235.000	217.000
Caterpillar	G-353	250	r	NSCR		647.000	5.000	0.000	6113.000	22.000	3/27/1991	0.100	6.000	1734.000	193.000
Caterpillar	G-353	250	r	JM CC	c	0.000	29.000	0.000	208.000	0.000	3/27/1992	2.000	3.000	63.000	169.000
Clark	HRA-3	330	l	None	m	0.000	269.000	0.000	230.000	1007.000	2/19/1991	13.800	0.000	192.000	1328.000
Clark	HRA-3	330	l	None	m	0.000	342.000	0.000	274.000	1794.000	2/19/1991	14.600	0.000	256.000	1418.000
Clark	HRA-6	660	l	Nergas SCR	c	1094.000	180.000	83.500	246.000	346.800	12/22/1986	14.200	305.391	216.627	0.000
Clark	HRA-6-M	660	l	Nergas SCR	c	0.000	33.000	0.000	159.000	243.000	5/4/1993	13.300	189.000	123.000	2767.000
Clark	HRA-6	660	l	Nergas SCR	c	885.000	104.000	88.200	301.000	245.500	5/6/1988	13.600	132.305	243.274	2770.000
Clark	HRA-6	660	l	Nergas SCR	c	636.000	55.000	91.352	481.000	260.000	5/2/1989	13.100	196.667	363.833	2187.000
Clark	HRA-6	660	l	Nergas SCR	c	1312.000	166.000	87.300	239.000	0.000	4/23/1990	13.100	0.000	180.000	2246.000
Clark	HRA-6-M	660	l	SCR Nergas		1089.000	77.000	92.900	301.000	72.000	4/22/1991	12.200	48.000	203.000	1984.000
Clark	HRA-6	660	l	Nergas SCR	c	562.000	64.000	88.612	167.000	300.000	6/12/1992	14.400	273.000	152.000	631.000
Clark	HRA-6	660	l	None	m	1113.000	0.000	0.000	207.000	339.000	2/19/1991	13.000	0.000	155.000	2877.000
Clark	HRA-6	660	l	Nergas SCR	m	52.000	52.000	0.000	296.000	211.000	8/27/1993	13.200	163.000	228.000	2318.000
Clark	HRA-6-M	660	l	SCR Nergas		1100.000	124.000	88.700	705.000	126.000	4/22/1991	12.600	89.000	498.000	2080.000
Clark	HRA-6	660	l	Nergas SCR	c	1159.000	155.000	86.600	290.000	200.900	8/26/1988	13.500	160.177	231.216	2770.000
Clark	HRA-6	660	l	Nergas SCR	c	672.000	82.000	87.800	284.000	227.000	3/26/1987	14.100	196.956	246.412	0.000
Clark	HRA-6-M	660	l	Nergas SCR	c	0.000	51.000	0.000	352.000	246.000	5/4/1993	12.700	177.000	253.000	2582.000
Clark	HRA-6	660	l	Nergas SCR	c	619.000	72.000	88.400	267.000	112.500	5/23/1989	13.900	95.000	225.000	2642.000
Clark	HRA-6	660	l	Nergas SCR	c	1237.000	222.000	82.100	256.000	0.000	4/23/1990	13.000	0.000	191.000	2246.000
Clark	HRA-6	660	l	Nergas SCR	c	679.000	83.000	87.776	402.000	387.000	6/12/1992	15.200	401.000	416.000	719.000
Clark	HRA-6	660	l	None	m	0.000	342.000	0.000	125.000	1616.000	2/19/1991	14.800	0.000	122.000	2799.000
Clark	HRA-6	660	l	None	m	0.000	304.000	0.000	389.000	1003.000	2/19/1991	13.750	0.000	321.000	2358.000
Waukesha	F817GU	90	r	Cat Conv	c	0.000	11.000	0.000	2162.000	181.000	5/4/1993	0.100	52.000	613.000	10.000
Ingersoll-Rand	XVG	350	r	TWC	m	81.000	48.000	40.700	12786.000	638.000	8/25/1988	8.900	313.683	6286.450	99.000
Ingersoll-Rand	XVG	350	r	TWC	m	195.000	2.000	99.000	21339.000	109.000	1/7/1988	1.500	33.149	6489.696	129.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ECS	c	0.000	238.000	0.000	81.000	0.000	2/6/1987	16.510	0.000	108.614	0.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ESC	c	218.000	218.000	0.000	123.000	0.000	8/22/1986	0.000	0.000	164.932	0.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ECS	c	65.000	65.000	0.000	120.000	47.000	5/5/1986	16.800	67.634	172.683	0.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ESC	c	0.000	96.920	0.000	0.000	0.000	5/8/1987	16.710	0.000	0.000	5992.300
Cooper Bessemer	GMVA-8	1110	l	Clean Burn ESC	c	71.000	71.000	0.000	141.000	0.000	10/31/1986	0.000	0.000	189.068	0.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ECS	c	64.000	64.000	0.000	130.000	29.000	2/6/1986	16.600	39.791	178.372	0.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ESC	c	0.000	1096.000	0.000	0.000	0.000	10/30/1989	15.400	0.000	0.000	5021.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ESC	c	0.000	248.000	0.000	0.000	0.000	1/8/1988	16.560	0.000	0.000	7500.000
Cooper Bessimer	GMVA-8	717	l	Clean Burn		0.000	910.770	0.000	0.000	0.000	7/27/1984	15.130	0.000	53.120	4818.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Cooper Bessimer	GMVA-8	717	l	Clean Burn		0.000	604.840	0.000	0.000	0.000	9/28/1984	15.960	0.000	154.320	5487.000
Cooper Bessemer	GMVA-8	1100	l	Clean Burn ESC	c	0.000	302.000	0.000	59.000	43.000	1/13/1989	16.070	0.755	72.300	5499.000
Superior	16SGTA	2650	l	Clean Burn		0.000	42.000	0.000	365.000	42.900	8/9/1994	7.600	19.000	162.000	5504.000
Superior	16SGTA	2650	l	Lndfl Gas		0.000	50.000	0.000	325.000	193.000	6/1/1994	7.400	0.000	142.000	4416.000
Superior	16SGTA	2650	l	Landfill Gas		0.000	31.320	0.000	210.010	8.300	5/28/1991	8.520	0.000	100.080	636.000
Superior	16SGTA	2550	l	Landfill Gas		0.000	46.450	0.000	361.090	19.750	2/3/1992	7.910	8.970	164.310	6122.100
Superior	16SGTA	2650	l	Clean Burn		0.000	42.400	0.000	0.000	0.000	11/17/1993	8.300	0.000	191.000	5535.000
Superior	16SGTA	2650	l	Landfill Gas		0.000	52.000	0.000	303.000	26.000	7/21/1993	7.800	12.000	136.000	6575.000
Superior	16SGTA	2650	l	Clean Burn	e	52.000	52.000	0.000	307.000	0.000	8/25/1987	0.000	0.000	152.210	0.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	45.000	0.000	374.000	0.000	12/20/1988	8.440	0.000	177.095	5368.620
Superior	16SGTA	2650	l	Clean Burn	e	0.000	44.000	0.000	237.000	19.800	6/1/1990	7.980	0.700	8.384	6377.000
Superior	16SGTA	2650	l	Clean Burn	e	42.000	42.000	0.000	0.000	0.000	8/14/1986	0.000	0.000	0.000	0.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	35.000	0.000	287.000	0.000	10/6/1988	11.600	0.000	182.075	5143.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	79.300	0.000	0.000	0.000	6/16/1989	7.400	3.600	119.100	5175.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	30.000	0.000	339.000	0.000	1/26/1988	8.200	0.000	168.076	5826.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	24.000	0.000	323.000	0.000	4/26/1988	8.300	0.000	160.143	4936.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	49.000	0.000	362.000	0.000	8/18/1988	7.900	0.000	179.479	4367.000
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	40.500	0.000	315.600	110.280	12/7/1995	7.760	49.670	140.700	5669.000
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	53.200	0.000	397.400	56.500	3/12/1996	7.980	25.900	181.400	5929.500
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	44.000	0.000	423.260	457.000	7/15/1997	7.870	20.700	193.270	5505.000
Superior	16SGTA	2650	l	Landfill Gas		0.000	45.000	0.000	324.000	24.000	7/21/1993	7.400	10.000	142.000	6502.000
Superior	16SGTA	2650	l	Clean Burn		0.000	40.800	0.000	0.000	0.000	11/17/1993	7.800	0.000	192.000	5779.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	78.000	0.000	362.000	21.900	6/1/1990	8.040	0.769	12.710	5055.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	70.600	0.000	268.000	0.000	12/20/1988	8.260	0.000	125.095	5394.550
Superior	16SGTA	2650	l	Clean Burn	e	39.000	39.000	0.000	331.000	0.000	8/25/1987	0.000	0.000	164.109	0.000
Superior	16SGTA	2650	l	Clean Burn	e	43.000	43.000	0.000	0.000	0.000	8/14/1986	0.000	0.000	0.000	0.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	75.000	0.000	377.000	0.000	4/26/1988	7.100	0.000	186.916	4513.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	76.000	0.000	356.000	0.000	1/26/1988	7.600	0.000	176.504	5564.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	89.000	0.000	434.000	0.000	8/18/1988	7.000	0.000	215.176	4130.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	77.000	0.000	407.000	0.000	10/7/1988	8.900	0.000	200.108	6415.000
Superior	16SGTA	2650	l	Clean Burn	e	0.000	81.500	0.000	0.000	0.000	6/16/1989	7.500	4.200	141.000	5214.000
Superior	16SGTA	2650	l	Clean Burn		0.000	28.000	0.000	357.000	42.300	8/9/1994	7.300	18.400	155.000	5531.000
Superior	16SGTA	2650	l	Landfill Gas		0.000	39.830	0.000	263.490	10.600	5/28/1991	8.550	0.000	125.840	556.000
Superior	16SGTA	2650	l	Lndfl Gas		0.000	38.000	0.000	367.000	102.000	6/1/1994	8.100	0.000	170.000	4977.000
Superior	16SGTA	2550	l	Landfill Gas		0.000	54.890	0.000	386.290	15.760	2/3/1992	8.040	7.230	177.220	6178.400
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	37.500	0.000	290.800	35.800	7/15/1997	7.610	15.900	130.200	5343.000
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	48.700	0.000	388.600	19.000	3/12/1996	7.920	8.700	176.500	6127.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	GMVA-8	165	r	ECS NOx Control		174.000	19.000	89.100	30000.000	394.100	6/15/1987	1.000	116.844	8894.472	0.000
Waukesha	GMVA-8	165	r	ECS NOx Control		384.000	23.000	94.000	9283.000	0.000	7/2/1986	0.000	0.000	2752.246	0.000
Ajax	DP-230	230	l			0.000	8.000	0.000	174.000	2342.000	9/24/1987	17.600	4187.212	311.091	1592.000
Ajax	DP-230	230	l			0.000	7.000	0.000	133.000	2365.000	9/24/1987	16.300	3033.370	170.587	1101.000
Waukesha	L7042G-	858	r	NSCR	c	691.000	18.000	97.400	1528.000	0.000	5/27/1987	0.400	0.000	433.423	490.100
Waukesha	L7042G-	775	r	Engelhardt CC	c	635.000	1.000	99.800	12229.000	0.000	10/19/1987	0.010	0.000	3468.803	471.800
Waukesha	L7042G-	858	r	NSCR	c	1074.000	16.000	98.500	9980.000	14.500	2/4/1987	0.010	4.236	2818.669	531.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	391.400	17.600	0.000	4790.000	0.000	6/29/1988	0.400	0.000	1358.702	519.200
Waukesha	L7042G-	775	r	NSCR		410.000	24.000	94.000	12454.000	182.000	4/5/1991	0.400	53.000	3584.000	419.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	736.000	16.000	0.000	710.000	0.000	3/22/1988	0.010	0.000	201.394	519.200
Waukesha	L7042G-	775	r	Engelhardt CC	c	769.000	16.000	97.900	466.000	0.000	12/8/1987	0.010	0.000	132.183	440.900
Waukesha	L7042G-	775	r	Englehard NSCR	c	448.000	8.000	98.000	9561.000	0.000	6/5/1989	0.100	0.000	26990.383	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	513.000	5.000	99.000	10040.000	0.000	12/12/1989	0.100	0.000	28342.584	593.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	458.000	21.000	95.000	11524.000	0.000	9/13/1989	0.100	0.000	32531.866	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	425.000	6.000	99.000	13772.000	0.000	4/9/1990	0.100	0.000	38877.895	594.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	591.000	16.000	99.000	5550.000	0.000	3/30/1989	0.100	2.000	15667.464	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	565.000	38.000	93.000	6332.000	0.000	9/19/1990	0.100	0.000	17875.024	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	648.600	15.000	0.000	2774.000	0.000	6/29/1988	0.010	0.000	786.856	591.200
Waukesha	L7042G-	775	r	Engelhardt CC	m	641.000	18.000	97.200	5714.000	0.000	9/22/1987	0.100	0.000	1620.798	635.800
Waukesha	L7042G-	775	r	Engelhardt CC	m	571.000	29.000	94.900	10921.000	0.000	12/8/1987	0.010	0.000	3097.784	581.200
Waukesha	L7042G-	858	r	Woodward Govern	m	596.000	18.000	97.000	8957.000	0.000	3/10/1987	0.010	0.000	2540.688	640.000
Waukesha	L7042G-	858	r	NSCR	m	597.000	55.000	90.800	5300.000	0.000	5/27/1987	0.100	0.000	1503.365	687.900
Waukesha	L7042G-	775	r	Engelhardt CC	m	582.000	64.000	0.000	8896.000	0.000	3/22/1988	0.010	0.000	2523.385	591.200
Waukesha	L7042G-	775	r	Englehard NSCR	m	532.000	44.000	92.000	9310.000	0.000	4/9/1990	0.100	0.000	26281.818	593.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	629.000	31.000	95.000	5475.000	0.000	6/30/1989	0.100	31.000	15455.742	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	513.000	12.000	97.000	8482.000	0.000	3/30/1989	0.100	12.000	23944.402	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	690.000	18.000	97.000	2800.000	0.000	12/12/1989	0.100	0.000	7904.306	591.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	669.000	14.000	98.000	1680.000	0.000	9/13/1989	0.100	0.000	4742.584	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	171.000	5.000	97.000	44446.000	0.000	3/9/1990	0.100	0.000	125469.569	599.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	1227.000	0.000	0.000	525.000	0.000	12/1/1982	5.000	0.000	195.000	0.000
Waukesha	L7042G-	775	r	NSCR		596.000	34.000	94.000	5315.000	162.000	4/5/1991	0.100	46.000	1508.000	666.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	452.000	37.000	91.000	13440.000	0.000	9/19/1990	0.100	0.000	37940.670	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	628.000	5.000	99.200	11033.000	0.000	12/16/1982	0.600	0.000	9753.000	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	657.600	55.600	0.000	2175.000	0.000	6/29/1988	0.010	0.000	616.947	547.600
Waukesha	L7042G-	775	r	Engelhardt CC	c	630.000	53.000	91.600	7607.000	0.000	9/22/1987	0.010	0.000	2157.755	592.300
Waukesha	L7042G-	858	r	Woodward Govern	c	618.000	43.000	93.000	7329.000	0.000	3/10/1987	0.010	0.000	2078.899	599.000
Waukesha	L7042G-	775	r	NSCR		498.000	1.000	99.000	2329.000	61.000	6/5/1991	0.010	17.000	657.000	555.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042G-	775	r	Engelhardt CC	c	674.000	50.000	93.500	3028.000	0.000	12/8/1987	0.010	0.000	858.904	598.600
Waukesha	L7042G-	775	r	Engelhard CC		0.000	5.000	0.000	4689.000	470.000	9/16/1993	0.100	134.000	1330.000	325.000
Waukesha	L7042G-	858	r	NSCR		0.000	3.000	0.000	10018.000	190.000	8/29/1994	0.400	55.000	2883.000	479.000
Waukesha	L7042G-	858	r	NSCR	c	583.000	45.000	92.300	3123.000	0.000	5/27/1987	0.200	0.000	885.851	590.200
Waukesha	L7042G-	775	r	Engelhardt CC	c	697.000	47.000	0.000	558.000	0.000	3/22/1988	0.010	0.000	158.279	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	52.000	4.000	92.000	40855.000	0.000	6/5/1989	0.100	0.000	115332.297	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	626.000	5.000	99.000	1420.000	0.000	9/13/1989	0.100	0.000	4008.612	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	640.000	46.000	93.000	3665.000	0.000	3/9/1990	0.200	0.000	5173.086	592.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	71.000	10.000	87.000	41720.000	0.000	3/30/1989	0.100	9.000	117774.163	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	619.000	67.000	89.000	3500.000	0.000	12/12/1989	0.100	0.000	9880.383	592.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	3.000	0.000	2645.000	0.000	10/1/1992	1.500	0.000	806.000	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	282.000	2.600	99.000	975.000	0.000	4/20/1983	0.010	0.000	0.000	1125.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	3.000	0.000	7061.000	653.000	6/19/1992	0.100	185.000	2003.000	350.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	700.600	0.850	0.000	4875.000	0.000	4/6/1982	0.100	0.000	1386.000	1051.000
Waukesha	L7042G-	585	r	NSCR	c	0.000	2.300	0.000	118.000	61.000	11/27/1996	0.010	17.000	33.000	396.000
Waukesha	L7042G-	513	r	NSCR	c	970.000	8.000	99.200	14746.000	42.000	2/24/1987	0.010	11.862	4164.739	616.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	617.000	12.000	0.000	6480.000	0.000	3/22/1988	0.010	0.000	1838.077	525.200
Waukesha	L7042G-	858	r	NSCR	c	839.000	3.000	99.600	201.000	0.000	5/29/1987	0.010	0.000	57.014	501.200
Waukesha	L7042G-	775	r	Engelhardt CC	c	694.000	22.000	96.800	2738.000	0.000	12/8/1987	0.010	0.000	776.644	546.900
Waukesha	L7042G-	775	r	Engelhardt CC	c	620.000	20.000	96.800	4750.000	0.000	9/22/1987	0.400	0.000	1347.356	573.900
Waukesha	L7042G-	775	r	Engelhardt CC	c	684.500	12.800	0.000	7556.000	0.000	6/29/1988	0.100	0.000	2143.288	525.200
Waukesha	L7042G-	775	r	Englehard NSCR	c	372.000	17.000	96.000	16830.000	0.000	12/28/1989	0.200	0.000	23755.263	593.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	442.000	9.000	98.000	18620.000	0.000	3/5/1990	0.100	0.000	52563.636	595.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	337.000	11.000	97.000	21040.000	0.000	6/5/1989	0.100	0.000	59395.215	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	495.000	21.000	96.000	1735.000	0.000	3/31/1989	0.100	20.000	4897.847	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	363.000	12.000	97.000	17438.000	0.000	9/14/1989	0.100	0.000	49226.890	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	360.000	20.000	94.000	15294.000	0.000	9/19/1990	0.200	0.000	21587.225	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	407.000	13.000	96.700	5000.000	0.000	6/6/1990	0.010	0.000	1410.000	595.000
Waukesha	L7042G-	775	r	NSCR		424.000	20.000	95.000	703.000	22.000	6/5/1991	0.010	6.000	198.000	556.000
Waukesha	L7042G-	838	r	NSCR		0.000	12.000	0.000	2272.000	187.000	8/19/1994	0.100	53.000	644.000	468.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	714.000	6.000	99.200	390.000	0.000	12/8/1987	0.010	0.000	110.625	532.300
Waukesha	L7042G-	775	r	Engelhard CC		0.000	7.000	0.000	4482.000	35.000	9/16/1993	0.100	10.000	1271.000	357.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	706.000	42.000	0.000	4000.000	0.000	3/22/1988	0.010	0.000	1134.615	456.900
Waukesha	L7042G-	775	r	Engelhardt CC	c	576.000	15.000	97.400	4021.000	0.000	9/22/1987	0.300	0.000	1140.572	563.200
Waukesha	L7042G-	775	r	Engelhardt CC	c	637.700	8.000	0.000	8874.000	0.000	6/29/1988	0.100	0.000	2517.144	456.900
Waukesha	L7042G-	858	r	NSCR	c	691.000	11.000	98.400	3806.000	0.000	5/29/1987	0.200	0.000	1079.587	609.000
Waukesha	L7042G-	858	r	NSCR	c	1204.000	5.000	99.600	11498.000	74.000	2/9/1987	0.010	20.900	3247.401	677.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042G-	775	r	Englehard NSCR	c	210.000	5.000	97.000	28600.000	0.000	6/5/1989	0.100	0.000	80736.842	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	252.000	12.000	95.000	22600.000	0.000	3/31/1989	0.100	12.000	63799.043	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	254.000	4.000	98.000	25525.000	0.000	12/28/1989	0.100	0.000	72056.220	595.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	185.000	2.000	99.000	29800.000	0.000	9/14/1989	0.100	0.000	84124.402	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	243.000	15.000	94.000	33766.000	0.000	3/5/1990	0.200	0.000	47660.144	597.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	12.000	0.000	6496.000	0.000	10/1/1992	1.100	0.000	1940.000	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	19.000	0.000	6875.000	2399.000	6/19/1992	0.500	694.000	1988.000	228.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	565.000	44.000	91.000	2576.000	0.000	9/19/1990	0.200	0.000	3635.981	0.000
Waukesha	L7042G-	775	r	NSCR		583.000	23.000	96.000	4246.000	31.000	6/5/1991	0.010	9.000	1199.000	532.000
Waukesha	L7042G-	775	r	NSCR-Englehard		0.000	18.000	0.000	2154.000	0.000	4/1/1996	0.010	0.000	608.000	428.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	635.000	17.000	0.000	4120.000	0.000	3/22/1988	0.010	0.000	1168.654	537.200
Waukesha	L7042G-	775	r	Engelhardt CC	m	660.000	10.000	98.500	6098.000	0.000	12/8/1987	0.100	0.000	1729.721	588.900
Waukesha	L7042G-	775	r	Engelhardt CC	m	668.000	21.000	96.900	679.000	0.000	9/22/1987	1.200	0.000	192.601	567.600
Waukesha	L7042G-	858	r	NSCR	m	950.000	3.000	99.700	9896.000	170.000	2/10/1987	0.400	48.927	2848.117	749.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	557.200	11.900	0.000	13388.000	0.000	6/29/1988	0.100	0.000	3797.558	537.200
Waukesha	L7042G-	775	r	Englehard NSCR	m	865.000	14.000	94.000	27100.000	0.000	9/14/1989	0.100	0.000	76502.392	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	464.000	32.000	93.000	12050.000	0.000	3/31/1989	0.100	32.000	34016.746	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	497.000	27.000	95.000	11150.000	0.000	3/5/1990	0.100	0.000	31476.077	594.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	472.000	15.000	97.000	6564.000	0.000	12/28/1989	0.100	0.000	18529.952	591.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	213.000	12.000	94.000	28500.000	0.000	6/5/1989	0.100	0.000	80454.545	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	505.000	32.000	94.000	10872.000	0.000	9/19/1990	0.100	0.000	30691.292	0.000
Waukesha	L7042G-	775	r	NSCR		499.000	26.000	95.000	10438.000	154.000	6/5/1991	0.010	44.000	2947.000	632.000
Waukesha	L7042G-	858	r	Woodward Govern	c	235.000	11.000	95.300	34064.000	0.000	3/10/1987	0.010	0.000	9662.385	645.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	227.200	10.500	0.000	29600.000	0.000	6/29/1988	0.100	0.000	8396.154	553.900
Waukesha	L7042G-	775	r	Engelhardt CC	c	206.000	16.000	0.000	26500.000	0.000	3/22/1988	0.010	0.000	7516.827	553.900
Waukesha	L7042G-	838	r	NSCR		0.000	32.000	0.000	7241.000	60.000	8/19/1994	0.100	17.000	2054.000	511.000
Waukesha	L7042G-	775	r	Engelhard CC		0.000	25.000	0.000	7920.000	306.000	9/16/1993	0.100	87.000	2247.000	524.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	255.000	23.000	91.000	26400.000	0.000	12/8/1987	0.010	0.000	7488.462	562.500
Waukesha	L7042G-	775	r	Engelhardt CC	c	280.000	18.000	93.600	38164.000	0.000	9/22/1987	0.200	0.000	10825.370	630.800
Waukesha	L7042G-	858	r	NSCR	c	333.000	27.000	91.900	21453.000	0.000	5/29/1987	0.010	0.000	6085.226	621.700
Waukesha	L7042G-	775	r	Englehard NSCR	c	144.000	3.000	98.000	34450.000	0.000	3/31/1989	0.100	2.000	97251.196	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	103.000	5.000	95.000	38019.000	0.000	9/14/1989	0.100	0.000	107326.364	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	127.000	11.000	91.000	43335.000	0.000	12/28/1989	0.400	0.000	30583.313	597.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	498.000	21.000	96.000	10920.000	0.000	4/9/1990	0.100	0.000	30826.794	594.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	116.000	6.000	95.000	40920.000	0.000	6/5/1989	0.100	0.000	115515.789	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	0.000	0.300	0.000	871.000	0.000	12/16/1982	0.010	0.000	762.000	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	560.000	47.000	91.000	7489.000	0.000	9/19/1990	0.100	0.000	21141.196	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042G-	775	r	Engelhardt CC	m	33.000	0.500	98.500	825.000	0.000	4/20/1983	0.010	0.000	0.000	1125.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	915.000	0.000	0.000	535.000	0.000	12/1/1982	4.800	0.000	196.000	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	14.000	0.000	3416.000	0.000	10/1/1992	1.400	0.000	1036.000	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	15.000	91.900	5000.000	0.000	6/6/1990	0.010	0.000	1410.000	594.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	32.000	0.000	10302.000	1201.000	6/19/1992	0.100	341.000	2922.000	336.000
Waukesha	L7042G-	585	r	NSCR	c	0.000	1.000	0.000	58.000	94.000	11/27/1996	0.010	26.000	16.000	616.000
Waukesha	L7042G-	775	r	NSCR-Englehard		0.000	47.000	0.000	7775.000	0.000	5/6/1996	0.010	0.000	2195.000	511.000
Waukesha	L7042G-	775	r	NSCR		462.000	10.000	0.000	29516.000	0.000	2/14/1986	0.100	0.000	0.000	566.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	573.000	18.940	0.000	4604.000	0.000	4/6/1982	0.100	0.000	1309.000	1051.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	1339.000	1274.000	4.850	1075.000	0.000	4/20/1983	2.730	0.000	0.000	1880.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	263.400	0.010	0.000	30984.000	0.000	6/29/1988	0.010	0.000	8788.731	608.600
Waukesha	L7042G-	775	r	Engelhardt CC	m	353.000	0.010	100.000	21295.000	0.000	12/8/1987	0.010	0.000	6040.409	622.200
Waukesha	L7042G-	775	r	Engelhardt CC	m	207.000	2.000	0.000	31801.000	0.000	3/22/1988	0.010	0.000	9020.476	608.600
Waukesha	L7042G-	858	r	Woodward Govern	m	475.000	0.010	100.000	15027.000	0.000	3/10/1987	0.010	0.000	4262.466	678.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	357.000	3.000	99.200	21143.000	0.000	9/22/1987	0.010	0.000	5997.293	675.400
Waukesha	L7042G-	858	r	NSCR	m	338.000	3.000	99.100	13750.000	0.000	5/27/1987	0.200	0.000	3900.240	659.100
Waukesha	L7042G-	775	r	Englehard NSCR	m	157.000	1.000	99.000	37638.000	0.000	6/5/1989	0.100	0.000	106250.813	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	191.000	2.000	99.000	34850.000	0.000	12/12/1989	0.100	0.000	98380.383	596.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	179.000	2.000	99.000	27950.000	0.000	9/13/1989	0.100	0.000	78901.914	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	202.000	1.000	99.000	34200.000	0.000	3/30/1989	0.100	0.010	96545.455	547.600
Waukesha	L7042G-	775	r	Engelhardt CC	m	627.000	2.000	99.700	4100.000	0.000	12/16/1982	0.700	0.000	3608.000	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	1239.000	0.000	0.000	333.000	0.000	12/1/1982	4.200	0.000	118.000	0.000
Waukesha	L7042G-	858	r	NSCR	c	677.000	2.000	99.700	2137.000	0.000	5/28/1987	0.010	0.000	606.168	691.300
Waukesha	L7042G-	775	r	Engelhardt CC	c	766.000	17.000	97.800	789.000	0.000	12/8/1987	0.010	0.000	223.803	668.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	605.000	10.000	0.000	3825.000	0.000	3/22/1988	0.010	0.000	1084.976	614.900
Waukesha	L7042G-	775	r	Engelhard CC		0.000	9.000	0.000	8675.000	423.000	9/16/1993	0.300	121.000	2485.000	378.000
Waukesha	L7042G-	858	r	Woodward Govern	c	345.000	38.000	89.000	23572.000	0.000	3/10/1987	0.010	0.000	6686.288	740.000
Waukesha	L7042G-	775	r	Engelhardt CC	c	531.000	8.000	98.500	9950.000	0.000	9/22/1987	0.010	0.000	2822.356	675.300
Waukesha	L7042G-	775	r	Engelhardt CC	c	618.900	8.500	0.000	2480.000	0.000	6/29/1988	0.100	0.000	703.462	614.900
Waukesha	L7042G-	775	r	Englehard NSCR	c	439.000	7.000	99.000	8985.000	0.000	12/12/1989	0.100	0.000	25364.354	592.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	380.000	7.000	98.000	20320.000	0.000	6/5/1989	0.100	0.000	57362.679	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	410.000	11.000	97.000	22045.000	0.000	3/9/1990	0.100	0.000	62232.297	595.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	285.000	10.000	96.000	18834.000	0.000	9/13/1989	0.100	0.000	53167.751	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	394.000	6.000	98.000	19400.000	0.000	3/31/1989	0.100	5.000	54765.550	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	c	699.000	17.000	97.000	2513.000	0.000	9/19/1990	0.100	0.000	7094.115	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	1501.000	0.000	0.000	402.000	0.000	12/1/1982	2.500	0.000	129.000	0.000
Waukesha	L7042G-	775	r	NSCR		398.000	5.000	99.000	12808.000	90.000	4/5/1991	0.600	26.000	3723.000	663.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042G-	775	r	Engelhardt CC	m	0.000	0.300	0.000	1200.000	0.000	12/16/1982	0.010	0.000	1049.000	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	10.000	0.000	2802.000	1085.000	6/19/1992	0.100	308.000	795.000	353.000
Waukesha	L7042G-	775	r	Englehard NSCR	c	0.000	3.000	0.000	9591.000	0.000	10/1/1992	1.200	0.000	2879.000	0.000
Waukesha	L7042G-	775	r	NSCR-Englehard		0.000	10.000	0.000	6303.000	0.000	4/1/1996	0.010	0.000	1779.000	393.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	335.000	6.000	98.200	21143.000	0.000	9/22/1987	0.010	0.000	5997.293	665.600
Waukesha	L7042G-	775	r	Engelhardt CC	m	386.000	7.000	0.000	16850.000	0.000	3/22/1988	0.010	0.000	4779.567	561.900
Waukesha	L7042G-	858	r	NSCR	m	512.000	8.000	98.400	6700.000	0.000	5/28/1987	0.600	0.000	1900.481	662.900
Waukesha	L7042G-	775	r	Engelhardt CC	m	283.000	1.000	99.600	23295.000	0.000	12/8/1987	0.010	0.000	6607.716	586.200
Waukesha	L7042G-	858	r	Woodward Govern	m	180.000	0.010	100.000	33955.000	0.000	3/10/1987	0.010	0.000	9631.466	607.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	254.800	1.100	0.000	31795.000	0.000	6/29/1988	0.010	0.000	9018.774	561.900
Waukesha	L7042G-	775	r	Englehard NSCR	m	144.000	3.000	97.000	35740.000	0.000	3/30/1989	0.100	3.000	100892.823	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	163.000	4.000	98.000	30500.000	0.000	9/13/1989	0.100	0.000	86100.478	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	135.000	1.000	99.000	39900.000	0.000	6/5/1989	0.100	0.000	112636.364	0.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	154.000	4.000	98.000	23447.000	0.000	12/12/1989	0.100	0.000	66190.096	595.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	1507.000	0.000	0.000	467.000	0.000	12/1/1982	3.600	0.000	160.000	0.000
Waukesha	L7042G-	775	r	NSCR		708.000	47.000	93.000	7081.000	93.000	6/5/1991	0.010	0.000	1999.000	579.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	674.000	33.000	94.000	3041.000	0.000	9/19/1990	0.200	0.000	4292.321	0.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	0.000	0.600	0.000	1740.000	0.000	12/16/1982	0.010	0.000	1521.000	0.000
Waukesha	L7042G-	858	r	NSCR	m	1614.000	2.000	99.900	16055.000	63.000	2/6/1987	0.010	17.793	4534.442	669.000
Waukesha	L7042G-	775	r	Engelhardt CC	m	767.000	1.000	0.000	20550.000	0.000	3/22/1988	0.010	0.000	5829.087	534.900
Waukesha	L7042G-	775	r	Engelhardt CC	m	765.200	4.600	0.000	4340.000	0.000	6/29/1988	0.100	0.000	1231.058	534.900
Waukesha	L7042G-	775	r	Engelhardt CC	m	539.000	1.000	99.800	14460.000	0.000	12/8/1987	0.010	0.000	4101.635	489.000
Waukesha	L7042G-	858	r	NSCR	m	773.000	1.000	99.900	213.000	0.000	5/29/1987	0.010	0.000	60.418	611.400
Waukesha	L7042G-	775	r	Engelhardt CC	m	494.000	2.000	99.600	38164.000	0.000	9/22/1987	0.010	0.000	10825.370	643.900
Waukesha	L7042G-	775	r	Englehard NSCR	m	493.000	6.000	99.000	25500.000	0.000	6/30/1989	0.100	5.000	71985.646	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	489.000	1.000	99.000	18775.000	0.000	3/31/1989	0.100	0.010	53001.196	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	385.000	3.000	99.000	20210.000	0.000	9/14/1989	0.100	0.000	57052.153	547.600
Waukesha	L7042G-	775	r	Englehard NSCR	m	409.000	13.000	97.000	27734.000	0.000	12/12/1989	0.100	0.000	78292.153	595.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	559.000	1.000	99.000	29389.000	0.000	3/9/1990	0.100	0.000	82964.163	596.000
Waukesha	L7042G-	775	r	Englehard NSCR	m	477.000	1.000	99.000	281.000	0.000	9/19/1990	1.300	0.000	61.020	0.000
Waukesha	L7042G-	775	r	NSCR		519.000	9.000	98.000	4926.000	68.000	6/5/1991	0.010	0.000	1391.000	526.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	17.200	0.000	159.000	0.000	5/24/1988	8.600	0.000	72.162	539.400
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	27.700	0.000	137.000	0.000	9/14/1988	8.100	0.000	62.177	689.800
Ingersoll-Rand	XVG-8	300	r	PSC	c	0.000	21.000	0.000	201.000	135.000	12/15/1994	8.300	63.000	94.000	633.000
Ingersoll-Rand	XVG	300	r	PSC	c	0.000	52.300	0.000	224.800	185.300	8/28/1992	7.400	0.000	98.200	537.100
Ingersoll-Rand	XVG	300	r	PSC	c	0.000	48.200	0.000	326.700	420.500	1/18/1991	10.300	0.000	0.000	619.100
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	78.700	0.000	61.000	0.000	4/25/1988	15.500	0.000	27.685	1772.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	44.000	94.600	0.000	0.000	5/17/1989	6.600	0.000	0.000	673.000
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	45.000	94.400	186.000	0.000	9/20/1989	6.590	0.000	7.968	623.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	814.000	20.000	97.543	0.000	0.000	2/22/1989	7.800	0.000	0.000	497.000
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	31.000	96.200	288.000	0.000	3/20/1990	7.600	0.000	10.698	340.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	67.200	0.000	212.000	52.000	12/21/1988	7.900	23.600	96.215	388.600
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	67.000	91.800	180.000	0.000	12/13/1989	7.000	0.000	7.259	352.000
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	13.500	98.340	196.000	0.000	9/24/1991	8.900	0.000	6.217	668.800
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	52.000	93.700	217.000	0.000	7/17/1990	7.800	0.000	7.854	525.000
Ingersoll-Rand	XVG	300	r	PSC	c	814.000	71.800	91.200	170.000	0.000	12/3/1991	9.200	0.000	5.216	596.000
Ingersoll-Rand	XVG-8	300	r	None	c	1118.800	0.000	0.000	0.000	0.000	12/17/1986	2.690	0.000	0.000	0.000
Ingersoll-Rand	XVG	300	r	PSC		814.090	54.870	93.260	178.400	0.000	1/8/1988	8.340	0.000	0.000	703.040
Ingersoll-Rand	XVG-8	300	r	PSC		0.000	112.000	0.000	219.000	1133.000	12/15/1994	13.400	891.000	172.000	1085.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	10.000	0.000	138.000	0.000	9/14/1988	9.400	0.000	69.590	609.900
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	40.800	0.000	94.000	0.000	5/24/1988	12.900	0.000	47.402	609.900
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	78.600	0.000	85.000	0.000	4/15/1988	12.300	0.000	42.863	867.900
Ingersoll-Rand	XVG-8	300	r	PSC		0.000	80.000	0.000	153.000	195.000	5/4/1995	13.100	149.000	116.000	994.000
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	77.000	95.000	191.000	0.000	12/13/1989	7.200	0.000	7.489	309.000
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	58.000	95.900	0.000	0.000	5/17/1989	8.800	0.000	0.000	540.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	1429.000	34.000	97.621	0.000	0.000	2/22/1989	9.200	0.000	0.000	432.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	53.500	0.000	199.000	14.000	12/21/1988	9.200	7.060	100.350	374.600
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	37.000	97.400	249.000	0.000	9/20/1989	8.650	0.000	8.126	464.000
Ingersoll-Rand	XVG	300	r	PSC		0.000	44.900	0.000	315.800	280.600	8/28/1992	9.400	0.000	161.500	542.500
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	1422.820	95.160	93.300	145.500	0.000	7/22/1987	8.500	0.000	0.000	0.000
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	96.600	93.200	555.000	0.000	12/3/1991	9.150	0.000	17.123	507.000
Ingersoll-Rand	XVG	300	r	PSC		0.000	67.800	0.000	164.700	15.500	1/18/1991	7.400	0.000	0.000	506.900
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	46.400	96.750	391.000	0.000	9/24/1991	8.800	0.000	12.543	644.400
Ingersoll-Rand	XVG	300	r	PSC	c	1429.000	45.000	96.900	276.000	0.000	7/17/1990	8.300	0.000	9.387	536.000
Ingersoll-Rand	XVG-8	300	r	PSC		1138.700	0.000	0.000	0.000	0.000	12/17/1986	3.460	0.000	0.000	0.000
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	68.000	0.000	108.000	0.000	4/16/1988	11.900	0.000	49.395	833.800
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	80.800	0.000	93.000	0.000	5/24/1988	8.700	0.000	42.535	442.600
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	21.300	0.000	152.000	0.000	9/14/1988	8.700	0.000	69.519	605.600
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	0.000	33.500	0.000	184.000	28.800	12/21/1988	8.400	13.594	86.848	334.600
Ingersoll-Rand	XVG	300	r	PSC PreStrat Ch	c	1090.000	26.000	97.615	0.000	0.000	2/22/1989	7.800	0.000	0.000	510.000
Ingersoll-Rand	XVG	300	r	PSC	c	1090.000	22.000	97.900	0.000	0.000	5/17/1989	7.800	0.000	0.000	583.000
Ingersoll-Rand	XVG	300	r	PSC	c	1090.000	68.000	93.800	152.000	0.000	9/20/1989	7.700	0.000	5.573	608.000
Ingersoll-Rand	XVG	300	r	PSC		1090.360	82.020	92.480	210.000	0.000	1/8/1988	9.290	0.000	0.000	627.910
Ingersoll-Rand	8UG1386	300	r			1207.000	0.000	0.000	0.000	0.000	12/17/1986	3.010	0.000	0.000	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ingersoll-Rand	XVG-8	300	r	PSC		0.000	51.000	0.000	219.000	222.000	12/15/1994	12.300	152.000	150.000	888.000
Ingersoll-Rand	XVG	300	r	PSC	c	991.000	19.000	98.100	177.000	0.000	3/19/1990	11.200	0.000	4.461	751.000
Ingersoll-Rand	XVG	300	r	PSC	c	991.000	93.000	90.100	153.000	0.000	7/17/1990	13.100	0.000	3.297	881.000
Ingersoll-Rand	XVG	300	r	PSC	c	991.000	61.900	93.750	202.000	0.000	9/24/1991	10.000	0.000	5.702	712.400
Ingersoll-Rand	XVG	300	r	PSC		0.000	77.400	0.000	206.800	185.300	8/28/1992	10.000	0.000	112.300	542.300
Ingersoll-Rand	XVG	300	r	PSC		0.000	47.400	0.000	136.000	374.000	1/18/1991	10.900	0.000	0.000	766.400
Ingersoll-Rand	XVG	300	r	PSC	c	991.000	50.200	94.900	306.000	0.000	12/3/1991	10.300	0.000	8.387	526.000
Ingersoll-Rand	XVG-8	300	r	Mone		982.800	0.000	0.000	0.000	0.000	12/17/1986	6.600	0.000	0.000	0.000
Ingersoll-Rand	XVG	300	r	None	s	1130.700	0.000	0.000	0.000	0.000	12/17/1986	1.620	0.000	0.000	0.000
Ingersoll-Rand	SVG-8	440	r	PSC PreStrat Ch	c	0.000	85.800	0.000	176.000	0.000	4/15/1988	7.200	0.000	76.353	760.300
Ingersoll-Rand	SVG-8	440	r	PSC	c	1260.910	83.400	93.390	159.200	0.000	1/8/1988	8.280	0.000	0.000	673.690
Ingersoll-Rand	SVG-8	440	r	PSC PreStrat Ch	c	0.000	68.600	0.000	160.000	0.000	5/24/1988	7.500	0.000	69.412	458.600
Ingersoll-Rand	SVG-8	440	r	PSC PreStrat Ch	c	0.000	70.300	0.000	160.000	0.000	9/14/1988	7.500	0.000	69.412	604.500
Ingersoll-Rand	SVG-8	440	r	PSC PreStrat Ch	c	1261.000	67.000	94.687	0.000	0.000	2/22/1989	7.300	0.000	0.000	691.000
Ingersoll-Rand	SVG-8	440	r	PSC PreStrat Ch	c	0.000	77.500	0.000	184.000	82.800	12/21/1988	7.300	35.921	79.824	360.500
Ingersoll-Rand	SVG-8	440	r	PSC	c	1261.000	87.000	93.100	137.000	0.000	9/20/1989	8.000	0.000	4.834	784.000
Ingersoll-Rand	SVG-8	440	r	PSC	c	1261.000	94.000	92.500	0.000	0.000	5/18/1989	9.100	0.000	0.000	865.000
Waukesha	6LR077T	495				218.100	0.000	0.000	0.000	0.000	12/15/1986	1.680	0.000	0.000	0.000
Waukesha	6LR077T	495				343.500	0.000	0.000	0.000	0.000	12/15/1986	1.790	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	36.800	0.000	179.200	395.200	8/27/1992	14.010	0.000	153.700	0.000
Ajax	DCP-180	180	l	Clean Burn	c	51.000	51.000	0.000	102.000	1589.000	8/7/1987	13.600	1284.260	82.438	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	60.000	0.000	0.000	0.000	5/17/1989	13.500	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	42.000	0.000	0.000	0.000	3/20/1990	13.300	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	33.000	0.000	111.000	680.000	6/14/1990	13.300	14.433	2.356	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	83.000	0.000	12/12/1989	15.900	0.000	1.474	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	116.000	0.000	9/19/1989	13.200	0.000	2.481	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	40.000	0.000	124.000	307.000	9/23/1991	13.200	6.566	2.652	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	48.000	0.000	165.000	885.000	11/29/1995	12.200	600.000	112.000	440.000
Ajax	DCP-180	180	l	Clean Burn	c	35.000	35.000	0.000	177.000	0.000	2/9/1987	0.000	0.000	132.190	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	25.000	0.000	129.000	0.000	9/13/1988	13.900	0.000	110.304	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	44.400	0.000	0.000	0.000	6/10/1988	14.400	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	56.000	56.000	0.000	150.000	0.000	4/23/1987	0.000	0.000	112.025	0.000
Ajax	DCP-180	180	l	Clean Burn	c	55.000	55.000	0.000	131.000	990.000	8/6/1987	13.000	739.367	97.835	0.000
Ajax	DCP-180	180	l	Clean Burn	c	78.000	78.000	0.000	170.000	0.000	7/3/1986	0.000	0.000	126.962	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	49.600	0.000	150.000	0.000	4/18/1988	15.100	0.000	128.261	0.000
Ajax	DCP-180	180	l	Clean Burn	c	51.000	51.000	0.000	144.000	0.000	10/2/1986	0.000	0.000	107.544	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	71.000	0.000	125.000	0.000	12/12/1989	14.400	0.000	2.450	0.000

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ajax	DCP-180	180	l	Clean Burn	c	57.200	57.200	0.000	0.000	0.000	2/21/1989	14.000	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	83.500	0.000	157.800	75.300	12/1/1988	14.900	74.045	155.367	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	134.000	775.000	6/14/1990	14.200	15.407	2.664	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	106.000	0.000	9/19/1989	13.700	0.000	2.184	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	60.000	0.000	0.000	0.000	5/17/1989	14.800	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	37.000	0.000	0.000	0.000	3/20/1990	13.600	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	25.000	0.000	113.000	275.000	9/23/1991	13.700	5.667	2.328	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	40.000	0.000	110.000	1840.000	3/30/1983	16.000	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	49.500	0.000	146.300	566.800	8/27/1992	14.400	0.000	133.500	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	78.200	0.000	159.000	0.000	4/18/1988	15.600	0.000	159.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	39.000	39.000	0.000	113.000	0.000	1/9/1987	0.000	0.000	113.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	28.000	28.000	0.000	155.000	0.000	4/22/1987	0.000	0.000	155.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	28.000	28.000	0.000	195.000	0.000	10/2/1986	0.000	0.000	195.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	60.100	0.000	0.000	0.000	6/10/1988	15.600	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	53.000	53.000	0.000	129.000	862.000	8/6/1987	14.200	759.075	113.597	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	17.700	0.000	133.000	0.000	9/13/1988	14.800	0.000	133.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	49.000	49.000	0.000	227.000	0.000	7/2/1986	0.000	0.000	227.000	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	61.000	0.000	135.000	155.000	12/1/1994	13.540	124.000	108.000	717.000
Ajax	DCP-180	180	l	Clean Burn	c	60.900	60.900	0.000	0.000	0.000	2/21/1989	15.400	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	55.000	0.000	0.000	0.000	5/17/1989	13.100	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	41.000	0.000	0.000	0.000	3/20/1990	14.200	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	44.400	0.000	154.600	129.000	12/1/1988	15.400	138.382	165.200	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	165.000	0.000	12/12/1989	13.200	0.000	3.529	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	45.000	0.000	156.000	1026.000	6/14/1990	14.700	19.703	2.996	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	32.000	0.000	172.000	0.000	9/19/1989	13.800	0.000	3.518	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	40.000	0.000	110.000	297.000	10/8/1982	15.600	0.000	0.000	1270.000
Ajax	DCP-180	180	l	Clean Burn		0.000	58.000	0.000	75.000	5200.000	3/30/1983	14.300	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	39.500	0.000	100.800	367.700	8/27/1992	13.200	0.000	77.500	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	45.000	0.000	176.000	674.000	9/23/1991	13.100	14.524	3.793	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	49.000	0.000	149.000	512.000	11/29/1995	13.600	414.000	120.000	541.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	20.600	0.000	93.000	0.000	9/13/1988	15.500	0.000	79.522	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	35.400	0.000	165.000	0.000	4/18/1988	15.200	0.000	141.087	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	28.000	0.000	0.000	0.000	6/10/1988	14.300	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	46.000	46.000	0.000	119.000	0.000	1/9/1987	0.000	0.000	101.754	0.000
Ajax	DCP-180	180	l	Clean Burn	c	18.000	18.000	0.000	103.000	0.000	10/2/1986	0.000	0.000	88.072	0.000
Ajax	DCP-180	180	l	Clean Burn	c	30.000	30.000	0.000	119.000	0.000	4/22/1987	0.000	0.000	101.754	0.000
Ajax	DCP-180	180	l	Clean Burn	c	60.000	60.000	0.000	110.000	768.000	8/7/1987	14.600	719.238	103.016	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ajax	DCP-180	180	l	Clean Burn	c	30.000	30.000	0.000	106.000	0.000	7/2/1986	0.000	0.000	90.638	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	156.000	0.000	12/12/1989	13.700	0.000	3.214	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	61.000	0.000	141.000	1357.000	6/14/1990	15.100	25.369	2.636	0.000
Ajax	DCP-180	180	l	Clean Burn	c	28.000	28.000	0.000	0.000	0.000	2/21/1989	13.200	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	45.000	0.000	128.000	0.000	9/19/1989	13.630	0.000	2.651	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	38.000	0.000	0.000	0.000	5/17/1989	12.700	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	45.400	0.000	158.600	23.200	12/1/1988	15.500	25.348	173.722	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	27.000	0.000	0.000	0.000	3/20/1990	14.000	0.000	0.000	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	48.100	0.000	292.800	216.200	8/27/1992	14.600	0.000	274.000	0.000
Ajax	DCP-180	180	l	Clean Burn	c	0.000	30.000	0.000	219.000	679.000	9/23/1991	13.700	13.991	4.513	0.000
Ajax	DCP-180	180	l	Clean Burn		0.000	26.000	0.000	97.000	565.000	11/29/1995	13.100	427.000	73.000	491.000
Minnepls-Moline	800-6A	80	r	NSCR		0.000	3.000	0.000	3305.000	115.000	6/15/1994	0.100	32.000	933.000	39.000
Minnepls-Moline	800-6A	80	r	NSCR		0.000	0.200	0.000	223.000	342.000	7/28/1994	0.100	97.000	63.000	73.000
Minneple-Moline	800-6A	80	r	NSCR		740.000	4.000	0.000	674.640	0.000	4/18/1991	0.010	2.300	190.000	66.570
Minnepls-Moline	800-6A	80	r	NSCR	c	0.000	6.400	0.000	627.500	72.500	5/21/1993	0.025	20.620	178.430	28.500
Minneple-Moline	800-6A	80	r	NSCR	c	0.000	8.450	0.000	1693.750	119.850	5/21/1993	0.210	34.090	485.770	28.800
Minnepls-Moline	800-6A	80	r	NSCR		0.000	6.000	0.000	582.000	15.000	7/13/1992	0.010	4.280	164.400	30.000
Minnepls-Moline	800-6A	80	r	NSCR	c	0.000	13.000	0.000	199.000	102.850	7/13/1992	0.050	29.000	56.240	45.000
Minnepls-Moline	800-6A	80	r	NSCR	c	0.000	20.030	0.000	2547.100	843.800	5/21/1993	0.015	239.750	723.920	28.500
Minneple-Moline	800-6A	80	r	NSCR		0.000	2.000	0.000	984.000	330.000	6/14/1994	0.100	93.000	278.000	40.000
Minnepls-Moline	800-6A	80	r	NSCR	c	0.000	6.000	0.000	1999.000	4.400	6/23/1992	0.010	1.230	564.000	0.000
Minneple-Moline	800-6A	80	r	NSCR		190.000	0.001	0.000	1515.850	0.000	4/18/1991	0.010	6.200	428.000	42.607
Ajax	K-6700D	180	l		d	0.000	53.700	0.000	153.000	0.000	6/24/1986	17.200	0.000	0.000	0.000
Ajax	K-6700D	180	l		d	0.000	57.600	0.000	160.000	0.000	6/24/1986	18.000	0.000	0.000	0.000
Ajax	DCP-140	140	l	Clean Burn(?)	c	0.000	9.820	0.000	367.260	963.100	5/21/1993	12.940	715.400	272.790	336.000
Ajax	DCP-140	140	l			0.000	14.270	0.000	20024.000	623.300	10/11/1991	14.660	586.520	189.500	455.000
Ajax	DCP-140	140	l	Unknown		0.000	33.100	0.000	0.000	0.000	3/15/1989	0.000	0.000	0.000	0.000
Ajax	DCP-140	140	l	Unknown-Clean?	c	0.000	68.800	0.000	348.000	153.000	9/19/1990	14.860	2.907	339.450	0.000
Ajax	DCP-140	140	l		c	0.000	6.000	0.000	456.000	631.000	7/13/1992	13.700	518.000	374.000	395.000
Caterpillar	G-342	225	r	ECS Cat Conv	c	436.000	2.000	99.500	17596.000	93.000	12/19/1987	0.100	26.380	4991.173	222.000
Caterpillar	G-342	225	r	ESC NSCR	c	618.000	17.000	97.200	3211.000	0.000	10/4/1989	0.070	0.000	909.500	0.000
Caterpillar	G-342	225	r	ECS Cat Conv	c	442.600	13.300	97.100	0.000	0.000	8/3/1988	0.010	0.000	0.000	0.000
Caterpillar	G-342	225	r	ECS NSCR	c	395.000	1.000	99.500	11212.000	110.000	7/28/1992	0.120	31.200	3183.400	186.000
Caterpillar	G-342	225	r	NSCR		542.000	6.000	0.000	8385.000	119.000	8/7/1991	0.400	34.000	2413.000	191.000
Caterpillar	G-342	225	r	NSCR EMS 42N/10		712.000	5.000	99.300	7475.000	117.000	3/14/1986	0.100	0.000	0.000	214.000
Caterpillar	G-342	225	r	ESC NSCR	c	566.000	15.000	97.360	7353.000	37.000	8/9/1990	0.380	26.300	2113.850	205.000
Cooper Bessemer	GMV	660	l	NergasGNA deNOx	d	304.000	151.000	50.300	0.000	0.000	10/23/1987	15.300	0.000	0.000	3161.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Cooper Bessemer	GMV	660	l	NergasGNA deNOx	d	0.000	154.650	0.000	0.000	0.000	8/4/1988	15.150	0.000	0.000	3141.000
Cooper Bessemer	GMV	660	l	Nergas		63.000	37.000	41.000	132.000	3800.000	1/29/1986	15.100	3800.000	0.000	732.000
Waukesha	L5790GU	748	r	NSCR		0.000	1.700	0.000	9158.000	105.800	7/11/1995	0.030	25.600	2588.600	655.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	625.000	9.000	99.000	0.000	0.000	10/20/1987	1.100	0.000	0.000	899.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	406.400	38.200	90.600	0.000	0.000	8/5/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	715.000	28.000	96.140	2567.000	1.500	10/4/1989	0.010	0.850	725.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44	d	514.000	19.000	96.300	9383.000	30.500	12/3/1986	0.010	8.614	2650.057	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	81.000	3.000	96.000	0.000	0.000	10/23/1987	0.050	0.000	0.000	979.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	389.000	48.000	87.550	11058.000	37.500	10/5/1989	0.020	23.900	3124.700	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	320.600	18.300	94.400	0.000	0.000	8/12/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	248.000	12.000	95.000	0.000	0.000	10/22/1987	0.010	0.000	0.000	857.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44	d	501.000	4.000	99.200	10854.000	22.300	12/2/1986	0.010	6.298	3065.515	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	161.600	2.900	98.100	0.000	0.000	8/4/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	546.000	29.000	94.750	7400.000	25.100	10/5/1989	0.070	16.000	2096.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	645.000	32.000	95.000	0.000	0.000	10/20/1987	0.010	0.000	0.000	890.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44	d	461.000	0.000	1.000	13287.000	22.300	12/2/1986	0.010	6.298	3752.671	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	181.700	9.200	94.900	0.000	0.000	8/4/1988	0.100	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	512.000	19.000	96.330	8533.000	23.800	10/5/1989	0.050	14.800	2415.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44	d	393.000	4.000	99.000	18242.000	25.800	12/3/1986	0.100	7.318	5174.413	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	778.000	10.000	98.700	0.000	0.000	10/23/1987	0.010	0.000	0.000	977.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	277.800	13.200	95.300	0.000	0.000	8/9/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo Nox 44	d	443.000	1.000	99.800	11983.000	18.600	12/3/1986	0.010	5.253	3384.380	0.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	587.000	25.000	95.660	7222.000	4.000	10/4/1989	0.010	2.550	2039.400	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	115.600	7.300	93.700	0.000	0.000	8/4/1988	0.190	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv		643.000	25.000	96.000	0.000	0.000	10/20/1987	0.200	0.000	0.000	1333.000
Ingersoll-Rand	SVG-12	660	r	ECS Lo NOx 44	d	426.000	19.000	95.500	15775.000	20.000	12/1/1986	0.100	5.673	4474.639	0.000
Ingersoll-Rand	SVG-12	660	r	ECS Cat Conv	d	156.800	5.600	96.200	0.000	0.000	8/5/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-12	660	r	NSCR	d	503.000	40.000	92.080	4775.000	28.800	10/5/1989	0.010	18.120	1348.000	0.000
White	G-8258	625	r	ECS Cat Conv	d	117.000	22.000	81.200	0.000	0.000	10/21/1987	1.000	0.000	0.000	990.770
White	G-8258	625	r	ECS Lo NOx 44	d	369.000	24.000	93.500	16945.000	18.700	12/5/1986	0.100	5.304	4806.514	0.000
White	G-8258	625	r	ECS Cat Conv	d	326.000	28.900	91.100	0.000	0.000	8/5/1988	0.010	0.000	0.000	0.000
White	G-8258	625	r	ECS Cat Conv	c	108.000	12.000	88.900	0.000	0.000	10/19/1987	0.030	0.000	0.000	853.000
White	G-8258	625	r	ECS Lo NOx 44	c	497.000	22.000	95.600	13750.000	22.500	12/4/1986	0.010	6.355	3883.437	0.000
White	G-8258	625	r	ESC Lo NOx 44		0.000	19.000	0.000	9131.000	20.000	10/6/1993	0.100	6.000	2578.000	693.000
White	G-8258	625	r	NSCR		244.000	2.000	99.300	10624.000	10.000	9/13/1991	0.100	3.000	2999.000	1085.000
White	G-8258	625	r	HIS	c	451.000	46.000	89.860	14363.000	18.200	10/2/1989	0.010	11.180	4055.400	0.000
White	G-8258	625	r	HIS	c	268.000	8.000	97.015	23750.000	0.000	3/23/1989	0.010	0.000	6704.000	800.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
White	G-8258	625	r	ECS Cat Conv	c	248.400	1.800	99.300	0.000	0.000	8/3/1988	0.010	0.000	0.000	0.000
White	G-8258	625	r	ESC		0.000	11.000	0.000	8807.000	47.000	8/2/1994	0.700	14.000	2572.000	691.000
White	G-8258	625	r	NSCR		281.000	6.120	97.800	10779.000	18.000	8/22/1991	0.370	10.200	3045.000	780.000
White	G-8258	625	r	HIS	c	1052.000	1.000	99.630	9203.000	29.000	8/15/1990	0.010	17.000	2598.000	651.000
White	G-8258	625	r	HIS	c	1765.000	2.000	99.510	5162.000	31.000	8/9/1990	0.010	18.860	1457.000	651.000
White	G-8258	625	r	HIS	c	362.000	12.000	96.600	9121.000	25.000	7/28/1992	0.110	7.210	2588.600	672.000
White	G-8258	625	r	NSCR		0.000	1.090	0.000	10103.600	15.700	7/11/1995	0.180	3.900	2875.900	718.000
White	G-8258	625	r	ECS Cat Conv	d	154.000	39.000	74.700	0.000	0.000	10/21/1987	0.900	0.000	0.000	1008.000
White	G-8258	625	r	ECS Lo NOx 44	d	585.000	47.000	92.000	11750.000	18.100	12/5/1986	0.100	5.134	3332.933	0.000
White	G-8258	625	r	ECS Cat Conv	d	303.300	22.700	92.400	0.000	0.000	8/5/1988	0.010	0.000	0.000	0.000
White	G-8258	625	r	ECS Lo NOx 44	d	306.000	27.000	91.200	18950.000	20.400	12/5/1986	0.100	5.787	5375.240	0.000
White	G-8258	625	r	ECS Cat Conv	d	165.000	27.000	83.600	0.000	0.000	10/21/1987	0.300	0.000	0.000	966.160
White	G-8258	625	r	ECS Cat Conv	d	595.700	50.000	91.600	0.000	0.000	8/5/1988	0.270	0.000	0.000	0.000
White	G-8258	625	r	ESC Lo NOx 44		0.000	15.000	0.000	6573.000	126.000	10/6/1993	0.100	36.000	1855.000	671.000
White	G-8258	625	r	ECS Cat Conv	c	324.000	38.000	88.300	0.000	0.000	10/19/1987	0.010	0.000	0.000	858.000
White	G-8258	625	r	ECS Lo NOx 44	c	478.000	19.000	96.000	14000.000	17.000	12/4/1986	0.010	4.801	3954.045	0.000
White	G-8258	625	r	NSCR		408.000	27.600	93.200	6453.000	60.000	8/22/1991	0.190	48.800	1822.000	720.000
White	G-8258	625	r	NSCR	c	390.000	39.000	89.980	13426.000	21.000	10/2/1989	0.050	13.130	3798.400	0.000
White	G-8258	625	r	ECS Cat Conv	c	507.200	36.100	92.900	0.000	0.000	8/3/1988	0.010	0.000	0.000	0.000
White	G-8258	625	r	NSCR	c	333.000	35.000	89.360	7967.000	33.750	8/9/1990	0.010	23.560	2250.000	717.000
White	G-8258	625	r	ESC		0.000	39.000	0.000	10872.000	67.000	8/2/1994	0.100	19.000	3084.000	703.000
White	G-8258	625	r	NSCR	c	666.000	18.000	97.400	13024.000	14.600	7/28/1992	0.030	4.120	3682.200	667.000
White	G-8258	625	r	NSCR		0.000	14.610	0.000	7142.600	22.700	7/11/1995	0.070	5.500	2022.900	673.800
Ingersoll-Rand	SVG-12	660	r	Cat Control	d	537.000	6.000	98.900	3600.000	110.000	2/9/1982	0.100	31.202	1021.154	0.000
Waukesha	L7042GU	1250	r	Cat Conv	c	662.450	37.640	0.000	0.000	0.000	2/22/1988	0.050	0.000	0.000	0.000
Waukesha	L7042GU	1250	r	JM Cat		0.000	0.300	0.000	6169.000	112.000	10/27/1993	0.100	32.000	1750.000	572.000
Waukesha	L7042GU	1250	r	Cat Conv	c	318.900	26.100	91.800	0.000	0.000	8/2/1988	0.020	0.000	0.000	0.000
Waukesha	L7042GU	1250	r	MEI Cat Muffler	c	572.000	39.000	93.200	12573.000	131.000	12/1/1987	0.100	37.159	3566.380	907.000
Waukesha	L7042GU	1250	r	NSCR	c	215.000	40.000	81.395	0.000	0.000	3/22/1989	0.030	0.000	0.000	518.000
Waukesha	L7042GU	1250	r	NSCR	c	613.000	44.000	92.840	13033.000	104.000	10/6/1989	0.010	77.250	3681.400	0.000
Waukesha	L7042GU	1250	r	NSCR	c	694.000	44.000	93.700	2643.000	84.000	7/29/1992	0.040	23.840	748.000	575.000
Waukesha	L7042GU	1250	r	NSCR		492.000	33.000	93.000	8238.000	156.000	9/13/1991	0.100	44.000	2326.000	813.000
Waukesha	L7042GU	900	r	MEI Cat		0.000	1.000	0.000	4586.000	67.000	5/25/1994	0.100	23.000	1301.000	1041.000
Waukesha	L7042GU	1250	r	NSCR	c	554.000	31.000	94.280	7947.000	79.000	8/6/1990	0.010	56.000	2244.000	582.000
Waukesha	L7042GU	900	r			0.000	12.000	0.000	4499.000	260.000	6/18/1997	0.300	75.000	1289.000	556.000
Waukesha	L7042GU	1250	r	NSCR		0.000	1.400	0.000	3862.200	36.700	7/12/1995	0.060	8.900	1093.200	553.900
Waukesha	L7042GU	1250	r	Cat Conv	c	426.200	27.600	93.400	0.000	0.000	8/10/1988	0.050	0.000	0.000	0.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042GU	1250	r	NSCR		504.000	14.000	97.000	10963.000	178.000	9/13/1991	0.100	51.000	3110.000	869.000
Waukesha	L7042GU	1250	r	MEI Cat Muffler	c	711.000	73.000	89.600	10993.000	135.000	12/11/1987	0.100	38.293	3118.207	1290.000
Waukesha	L7042GU	1250	r	Cat Conv	c	594.970	27.650	0.000	0.000	0.000	2/22/1988	0.020	0.000	0.000	0.000
Waukesha	L7042GU	900	r	MEI Cat		0.000	1.000	0.000	2128.000	34.000	5/25/1994	0.100	12.000	601.000	1104.000
Waukesha	L7042GU	1250	r	JM Cat		0.000	1.000	0.000	8061.000	37.000	10/7/1993	0.100	11.000	2287.000	672.000
Waukesha	L7042GU	1250	r	NSCR	c	564.000	42.000	92.530	13483.000	75.200	10/7/1989	0.010	53.630	3808.900	0.000
Waukesha	L7042GU	1250	r	NSCR	c	676.000	62.000	90.680	14050.000	135.800	8/6/1990	0.070	101.000	3979.000	757.000
Waukesha	L7042GU	1250	r	NSCR	c	497.000	18.000	96.400	3189.000	116.000	7/29/1992	0.040	33.000	902.000	548.000
Waukesha	L7042GU	900	r			0.000	19.000	0.000	8035.000	40.000	6/18/1997	0.100	11.000	2268.000	538.000
Waukesha	L7042GU	1250	r	NSCR		0.000	11.800	0.000	736.800	61.500	7/12/1995	0.740	16.000	215.600	509.100
Waukesha	L7042GU	1250	r	Cat Conv	c	841.500	11.500	98.600	0.000	0.000	8/1/1988	0.010	0.000	0.000	0.000
Waukesha	L7042GU	1250	r	MEI Cat Muffler	c	67.000	7.000	89.600	37612.000	307.000	12/1/1987	0.100	87.082	10668.790	931.000
Waukesha	L7042GU	1250	r	Cat Conv	c	209.870	18.430	0.000	0.000	0.000	2/22/1988	0.240	0.000	0.000	0.000
Waukesha	L7042GU	1250	r	NSCR	c	845.000	49.000	94.201	4460.000	0.000	3/23/1989	0.010	0.000	1257.000	517.000
Waukesha	L7042GU	1250	r	NSCR		494.000	45.000	91.000	8352.000	249.000	9/13/1991	0.100	70.000	2358.000	860.000
Waukesha	L7042GU	1250	r	NSCR	c	598.000	30.000	94.900	12524.000	107.000	7/29/1992	0.050	30.000	3544.000	594.000
Waukesha	L7042GU	900	r	MEI Cat		0.000	1.000	0.000	598.000	32.000	5/25/1994	0.100	10.000	169.000	1002.000
Waukesha	L7042GU	1250	r	NSCR	c	793.000	18.000	97.670	2522.000	78.000	8/6/1990	0.010	53.000	712.000	741.000
Waukesha	L7042GU	900	r			0.000	10.000	0.000	87.000	14.000	6/18/1997	0.100	4.000	25.000	627.000
Waukesha	L7042GU	1250	r	NSCR		0.000	23.200	0.000	2979.200	77.600	7/12/1995	0.040	18.800	842.700	751.000
Waukesha	L7042GU	1250	r	JM Cat		0.000	3.000	0.000	1357.000	379.000	10/27/1993	0.100	108.000	385.000	496.000
Waukesha	F1197GU	186	r	NSCR	c	641.500	56.900	91.140	720.000	0.000	8/31/1990	0.040	0.000	203.600	298.400
Waukesha	F1197GU	186	r	NSCR		397.000	59.000	85.000	3400.000	0.000	3/15/1994	0.030	0.000	961.000	306.000
Waukesha	F1197GU	186	r	NSCR	c	671.000	38.000	94.000	1106.000	0.000	3/16/1993	0.030	56.000	313.000	264.000
Waukesha	F1197GU	186	r	NSCR	c	655.000	38.000	94.170	4800.000	590.000	9/19/1989	0.030	167.000	1357.000	287.700
Waukesha	F1197GU	186	r	NSCR	c	684.000	45.000	93.430	1443.000	370.000	5/22/1990	0.020	104.500	407.700	301.300
Waukesha	F1197GU	186	r	NSCR		675.000	16.000	98.000	3267.000	0.000	6/12/1991	0.020	17.000	923.000	290.700
Waukesha	F1197GU	186	r	NSCR		0.000	20.000	0.000	1462.000	195.000	3/27/1995	0.040	55.000	414.000	237.000
Waukesha	F1197GU	186	r	NSCR	c	660.000	41.000	94.000	3343.000	0.000	3/10/1992	0.090	0.000	948.000	0.000
Waukesha	F1197FU	0	r	NSCR	c	0.000	38.000	0.000	1046.000	53.000	3/17/1997	0.030	15.000	296.000	231.000
Waukesha	F1197FU	0	r	NSCR		0.000	23.000	0.000	1127.500	145.000	3/27/1996	0.030	41.000	319.000	232.000
Waukesha	F1197GU	186	r	NSCR	c	734.000	30.000	96.000	1725.000	0.000	3/17/1993	0.030	58.000	488.000	275.000
Waukesha	F1197GU	186	r	NSCR		733.000	19.000	97.000	1455.000	0.000	3/17/1994	0.030	0.000	411.000	280.800
Waukesha	F1197GU	186	r	NSCR	c	647.000	17.000	97.340	4331.000	430.000	5/22/1990	0.030	122.000	1224.000	301.600
Waukesha	F1197GU	186	r	NSCR	c	714.000	46.000	93.620	1900.000	485.000	9/19/1989	0.040	137.000	537.000	291.800
Waukesha	F1197GU	186	r	NSCR	c	462.500	21.200	95.410	4200.000	0.000	8/31/1990	0.040	0.000	1187.900	312.100
Waukesha	F1197GU	186	r	NSCR	c	612.000	37.000	94.000	3043.000	0.000	3/11/1992	0.070	0.000	862.000	0.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F1197GU	186	r	NSCR		724.000	10.000	99.000	1230.000	0.000	6/13/1991	0.020	34.000	348.000	283.470
Waukesha	F1197GU	186	r	NSCR		0.000	21.000	0.000	1918.000	167.000	3/28/1995	0.050	47.000	543.000	229.000
Waukesha	F1197FU	0	r	NSCR	c	0.000	12.000	0.000	2829.000	125.000	3/20/1997	0.020	35.000	799.000	233.000
Waukesha	F1197FU	0	r	NSCR		0.000	31.000	0.000	1741.500	71.000	3/27/1996	0.040	20.000	492.000	230.000
Caterpillar	G-398	412	r	Cat Converter	c	0.000	17.000	0.000	3439.000	126.000	2/15/1994	0.100	36.000	971.000	389.000
Caterpillar	G-398	412	r	PSC Prestrat Ch	c	0.000	32.000	0.000	4202.000	171.000	3/5/1993	0.200	49.000	1198.000	331.000
Caterpillar	G-398	412	r	PSC PreStrat Ch	c	492.000	45.000	90.900	600.000	790.000	12/28/1987	8.800	385.207	292.562	0.000
Caterpillar	G-398	412	r	NSCR(removePSC)	c	0.000	8.000	0.000	2062.000	46.900	7/6/1989	0.090	147.108	584.700	465.000
Caterpillar	G-398	412	r	PSC PreStrat Ch	c	787.300	46.300	94.155	435.600	0.000	1/30/1989	7.830	0.000	196.600	0.000
Caterpillar	G-398	412	r	PSC PreStrat Ch	c	677.000	43.000	93.648	665.000	185.600	3/3/1989	8.100	85.550	306.523	0.000
Caterpillar	G-398	412	r	ESC NSCR	c	0.000	74.000	0.000	3725.000	799.000	5/17/1990	0.300	229.000	1067.000	410.000
Caterpillar	G-398	412	r	ESC NSCR	c	0.000	40.000	0.000	5500.000	53.000	12/19/1991	0.200	15.000	1568.000	230.000
Caterpillar	G-398	412	r	ESC NSCR	c	0.000	25.000	0.000	4859.000	0.000	5/11/1990	0.050	0.000	1375.000	0.000
Caterpillar	G-398	412	r	NSCR	c	0.000	33.000	0.000	4837.000	216.000	6/20/1995	0.100	61.000	1365.000	434.000
Caterpillar	G-398	412	r	NSCR	c	0.000	60.000	0.000	2200.000	0.000	8/19/1991	0.007	0.000	621.000	0.000
Caterpillar	G-398	412	r	ESC NSCR	c	0.000	21.000	0.000	1432.000	118.000	10/19/1990	0.040	33.000	405.000	0.000
Caterpillar	G-398	412	r	NSCR	c	0.000	28.400	0.000	5843.400	225.200	7/31/1996	0.290	64.500	1673.100	416.000
Caterpillar	G-398	412	r	NSCR		0.000	4.700	0.000	978.500	43.400	2/14/1997	0.030	12.300	276.600	445.200
Caterpillar	G-398	412	r	Cat Converter	c	0.000	28.000	0.000	6035.000	51.000	3/5/1993	0.100	5.000	1712.000	379.000
Caterpillar	G-398	412	r	NSCR	c	0.000	31.000	0.000	2000.000	0.000	8/19/1991	0.008	0.000	565.000	0.000
Caterpillar	G-398	412	r	Cat Converter	c	0.000	44.000	0.000	11988.000	108.000	2/21/1994	0.100	31.000	3392.000	410.000
Caterpillar	G-398	412	r	NSCR	c	0.000	46.000	0.000	12560.000	227.000	6/20/1995	0.100	64.000	3563.000	463.000
Caterpillar	G-398	412	r	Cat Converter	c	475.000	31.000	93.500	15571.000	228.000	4/26/1988	0.030	64.394	4397.745	369.000
Caterpillar	G-398	412	r	ECS NSCR	c	0.000	24.000	0.000	3755.000	60.770	12/7/1990	0.050	17.000	1063.000	0.000
Caterpillar	G-398	412	r	ECS NSCR	c	591.000	26.000	95.700	7891.000	168.000	12/19/1991	0.100	48.000	2227.000	305.000
Caterpillar	G-398	412	r	ECS NSCR	c	0.000	37.000	0.000	820.000	0.000	5/11/1990	0.010	0.000	231.000	0.000
Caterpillar	G-398	412	r	NSCR	c	0.000	9.000	0.000	765.900	113.500	7/31/1996	0.750	33.300	224.300	579.300
Caterpillar	G-398	412	r	Cat Converter	c	0.000	6.000	0.000	9211.000	211.000	2/21/1994	0.100	60.000	2613.000	417.000
Caterpillar	G-398	412	r	Cat Converter	c	0.000	8.000	0.000	4450.000	109.000	3/5/1993	0.100	31.000	1262.000	365.000
Caterpillar	G-398	412	r	Cat Converter	c	0.000	37.000	0.000	12369.000	213.000	5/10/1994	0.100	60.000	3492.000	415.000
Caterpillar	G-398	412	r	Cat Converter	c	85.300	10.500	0.000	30538.000	0.000	4/26/1988	0.010	0.000	8662.221	0.000
Caterpillar	G-398	412	r	NSCR	c	628.000	17.000	97.300	8015.000	0.000	7/27/1988	0.100	0.000	2273.486	363.000
Caterpillar	G-398	412	r	ESC NSCR	c	0.000	20.000	0.000	10731.000	315.000	10/19/1990	0.060	89.000	3037.000	0.000
Caterpillar	G-398	412	r	ECS NSCR	c	0.000	18.000	0.000	2961.000	0.000	5/11/1990	0.010	0.000	836.000	0.000
Caterpillar	G-398	412	r	NSCR	c	0.000	17.000	0.000	9428.000	303.000	6/20/1995	0.100	86.000	2674.000	397.000
Caterpillar	G-398	412	r	ECS NSCR	c	617.000	39.000	93.700	3484.000	111.000	12/19/1991	0.100	32.000	986.000	224.000
Caterpillar	G-398	412	r	NSCR	c	0.000	35.000	0.000	2500.000	0.000	8/19/1991	0.009	0.000	706.000	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Caterpillar	G-398	412	r	NSCR	c	0.000	3.600	0.000	1009.600	50.700	7/31/1996	0.150	14.400	287.100	444.500
Cooper Bessemer	GMV-8	800	l	SCR		669.000	44.000	0.000	310.000	1099.000	3/17/1988	13.800	0.000	0.000	4115.000
Cooper Bessemer	GMV-8	800	l	SCR		400.000	105.000	0.000	230.000	1058.000	5/10/1991	11.500	664.000	144.000	1032.000
Cooper Bessemer	GMV-8	800	l	Nergas SCR	m	683.000	61.000	90.200	1535.000	595.000	6/19/1989	11.700	381.000	986.000	1257.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	553.000	85.000	84.629	618.000	0.000	11/14/1988	14.100	0.000	536.206	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	609.000	77.000	87.400	262.000	1468.000	3/13/1987	13.700	1202.944	214.694	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	660.000	98.000	85.200	527.000	0.000	1/8/1988	13.500	0.000	420.176	0.000
Cooper Bessemer	GMV-8	800	l	Nergas SCR	m	532.000	58.000	89.200	456.000	776.000	3/2/1990	12.600	551.000	324.000	3984.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	576.000	38.000	93.403	1688.000	0.000	9/9/1988	12.900	0.000	1443.362	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	818.000	108.000	86.800	524.000	0.000	6/10/1987	0.000	0.000	429.389	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	638.000	46.000	92.790	795.000	0.000	6/23/1988	13.600	0.000	679.783	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	1100.000	83.000	92.500	300.000	434.000	8/3/1987	10.900	256.060	177.000	0.000
Cooper Bessemer	GMV-8	800	l	Kleenaire	m	779.000	132.000	83.100	730.000	2110.000	8/26/1987	13.200	1616.753	559.351	0.000
Cooper Bessemer	GMV-8	800	l	SCR		377.000	67.000	82.000	719.000	0.000	2/24/1989	12.700	0.000	0.000	0.000
Cooper Bessemer	GMV-8	800	l	Nergas SCR	m	0.000	45.000	0.000	560.000	0.000	6/20/1990	12.700	0.000	403.000	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	139.000	32.000	76.978	30917.000	0.000	6/13/1988	0.010	0.000	8769.726	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	43.000	1.000	97.674	77346.000	0.000	12/14/1988	0.100	0.000	21939.490	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	39.000	28.000	28.205	49856.000	0.000	9/14/1988	0.010	0.000	14141.850	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	359.000	4.000	98.886	8966.000	0.000	3/1/1988	0.010	0.000	2543.240	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	100.000	40.000	60.000	39533.000	0.000	11/8/1989	0.100	0.000	11160.000	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	407.000	2.000	99.500	12896.000	44.000	12/30/1987	0.010	12.427	3642.240	1457.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	404.000	3.000	99.300	11871.000	44.000	12/23/1987	0.100	12.427	3352.748	1438.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	148.000	24.000	83.800	30833.000	70.000	6/7/1989	0.010	20.000	8725.000	250.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	277.000	10.000	96.390	22335.000	0.000	3/17/1988	0.010	0.000	6308.114	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	306.000	0.100	99.900	19769.000	62.000	12/23/1987	0.010	17.511	5583.394	2532.000
Ingersoll-Rand	XVG-8	300	r	catalyst		57.000	22.000	61.404	47968.000	104.000	12/7/1988	0.100	29.500	13606.310	304.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	92.000	18.000	80.435	42813.000	0.000	9/16/1988	0.100	0.000	12091.750	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	s	129.000	41.000	68.217	30861.000	0.000	6/13/1988	0.010	0.000	8716.127	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	d	298.000	7.000	97.700	16649.000	38.000	12/23/1987	0.100	10.779	4722.553	1569.000
Ingersoll-Rand	XVG-8	300	r	NSCR	d	136.000	28.000	79.100	28399.000	0.000	6/23/1989	0.010	0.000	8036.000	0.000
Ingersoll-Rand	XVG-8	300	r	EnglehardTorvex	d	245.000	5.000	97.959	16193.000	55.000	12/7/1988	0.100	15.601	4593.207	256.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	d	196.000	3.000	98.469	19858.000	0.000	2/26/1988	0.010	0.000	5632.798	0.000
Ingersoll-Rand	XVG-8	300	r	EnglehardTorvex	d	431.000	9.000	97.912	5912.000	0.000	6/13/1988	0.010	0.000	1676.962	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	d	304.000	13.000	95.724	12538.000	0.000	9/14/1988	0.010	0.000	3556.452	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	217.000	43.000	80.300	25962.000	0.000	9/1/1989	0.200	0.000	7400.000	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	242.000	14.000	94.215	21038.000	0.000	12/6/1988	0.100	0.000	5967.510	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	260.000	6.000	97.692	19219.000	0.000	2/26/1988	0.010	0.000	5451.543	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	127.000	1.000	99.213	30345.000	0.000	6/17/1988	0.010	0.000	8607.476	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	276.000	22.000	92.000	21544.000	0.000	11/9/1989	0.100	0.000	6082.000	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR		117.000	10.000	91.400	27721.000	0.000	3/1/1989	0.010	0.000	0.000	259.000
Ingersoll-Rand	XVG-8	300	r	catalyst	d	64.000	17.000	73.400	79106.000	63.500	3/19/1986	0.100	18.012	22438.720	0.000
Ingersoll-Rand	XVG-8	300	r	catalyst	d	26.000	15.000	42.300	50561.000	0.000	6/16/1986	0.000	0.000	14341.820	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	337.000	16.000	95.300	10132.000	0.000	9/30/1987	0.000	0.000	2873.981	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	d	334.000	1.000	100.000	8033.000	1320.000	11/8/1989	0.100	373.000	2268.000	253.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	77.000	1.000	98.700	33500.000	0.000	9/25/1986	0.000	0.000	9502.404	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	105.000	27.000	74.286	37521.000	0.000	6/17/1988	0.010	0.000	10642.980	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	412.000	2.000	99.500	13700.000	0.000	3/4/1987	0.000	0.000	3886.058	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	90.000	39.000	56.667	38313.000	0.000	3/18/1988	0.010	0.000	10867.630	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	109.000	5.000	95.413	34922.000	0.000	9/16/1988	0.010	0.000	9905.760	0.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	277.000	35.000	87.400	16731.000	33.000	1/8/1988	0.010	9.361	4725.366	252.000
Ingersoll-Rand	XVG-8	300	r	JohnsonMatthey	d	149.000	2.000	98.700	33500.000	23.200	12/10/1986	0.010	6.552	9461.465	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex		0.000	8.000	0.000	9603.000	74.000	8/20/1993	0.100	21.000	2724.000	70.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	213.000	17.000	91.800	27904.000	0.000	6/7/1989	0.100	0.000	7934.000	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	103.000	3.000	97.087	37413.000	45.000	12/6/1988	0.100	12.764	10612.340	290.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	226.000	6.000	97.345	21313.000	0.000	9/14/1988	0.010	0.000	6045.514	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	216.000	4.000	98.148	20758.000	0.000	6/17/1988	0.010	0.000	5888.087	0.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	357.000	6.000	98.319	11808.000	0.000	3/17/1988	0.010	0.000	3349.385	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	369.000	25.000	93.000	15504.000	40.000	11/9/1989	0.100	11.000	4377.000	317.000
Ingersoll-Rand	XVG-8	300	r	EngelhardTorvex	s	259.000	5.000	98.100	19573.000	33.000	12/31/1987	0.100	9.320	5528.037	1756.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	79.000	22.000	72.500	39860.000	0.000	9/1/1989	0.100	0.000	11252.000	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR		296.000	9.000	96.900	13862.000	0.000	3/10/1989	0.010	0.000	0.000	0.000
Ingersoll-Rand	XVG-8	300	r	NSCR	s	0.000	30.000	0.000	1669.000	45.000	12/5/1991	0.200	13.000	476.000	101.000
Ingersoll-Rand	XVG-8	300	r	NSCR		0.000	21.000	0.000	2131.000	23.000	11/4/1992	3.300	8.000	714.000	117.000
Ingersoll-Rand	SVG-10	550	r	catalyst	s	169.000	5.000	97.000	73381.000	41.300	3/19/1986	0.400	11.886	21119.410	0.000
Ingersoll-Rand	SVG-10	550	r	catalyst	s	153.000	2.000	98.700	23640.000	0.000	6/18/1986	0.000	0.000	6705.577	0.000
Ingersoll-Rand	SVG-10	550	r			0.000	18.000	0.000	4072.000	40.000	1/18/1993	0.500	12.000	1178.000	213.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	344.000	13.000	96.200	35991.000	0.000	2/18/1987	0.000	0.000	10208.990	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	67.000	12.000	82.090	43638.000	0.000	2/26/1988	0.200	0.000	12378.090	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	58.000	25.000	56.897	47027.000	115.000	12/6/1988	0.300	32.937	13468.900	361.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	69.000	20.000	71.014	48248.000	0.000	6/13/1988	0.300	0.000	13685.730	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	69.000	23.000	66.667	49218.000	0.000	9/14/1988	0.300	0.000	13960.880	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	91.000	7.000	92.300	21303.000	0.000	6/9/1987	0.000	0.000	6042.678	0.000
Ingersoll-Rand	SVG-10	550	r	JMI NSCR	s	105.000	0.010	99.700	32675.000	0.000	6/7/1989	0.010	0.000	9246.000	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	283.000	30.000	89.400	16875.000	70.000	12/29/1987	0.010	19.770	4766.036	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ingersoll-Rand	SVG-10	550	r	NSCR	s	272.000	1.000	99.600	23600.000	0.000	9/11/1986	0.000	0.000	6694.231	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	142.000	9.000	93.700	24372.000	0.000	9/18/1987	0.000	0.000	7014.380	0.000
Ingersoll-Rand	SVG-10	550	r	NSCR	s	103.000	1.000	99.200	39946.000	0.000	9/6/1989	0.100	0.000	11277.000	0.000
Ingersoll-Rand	SVG-10	550	r	NSCR	s	390.000	1.000	99.200	12500.000	36.000	11/9/1989	0.100	10.000	3546.000	383.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey	s	65.000	1.000	98.500	48800.000	128.900	12/9/1986	0.200	36.740	13909.180	0.000
Ingersoll-Rand	SVG-10	550	r	JMI NSCR	s	0.000	3.000	0.000	139.000	6.000	12/16/1991	0.200	2.000	40.000	143.000
Ingersoll-Rand	SVG-10	550	r			88.000	28.000	68.700	51129.000	0.000	3/1/1989	0.600	0.000	0.000	0.000
Ingersoll-Rand	SVG-10	550	r	catalyst		260.000	17.000	93.500	18990.000	0.000	6/16/1986	0.000	0.000	5386.587	0.000
Ingersoll-Rand	SVG-10	550	r	Dupont 22-19PR5		432.000	61.000	85.900	9300.000	0.000	4/2/1982	0.000	0.000	2637.981	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey		42.000	1.000	97.600	51900.000	0.000	8/28/1986	0.000	0.000	14721.630	0.000
Ingersoll-Rand	SVG-10	550	r	JohnsonMatthey		180.000	1.000	99.400	16400.000	0.000	12/9/1986	0.000	0.000	4651.923	0.000
Waukesha	L5790GU	738	r	NSCR		0.000	16.000	0.000	3104.000	33.000	1/3/1991	0.100	9.000	876.000	419.000
Waukesha	L5790GU	738	r	Engelhard	c	127.000	1.000	99.300	48096.000	0.000	2/21/1989	0.100	0.000	0.000	0.000
Waukesha	L5790GU	738	r	EngelhardTorvex		0.000	17.000	0.000	10269.000	2.000	9/20/1993	0.100	0.500	2913.000	101.000
Waukesha	L5790GU	738	r	NSCR		0.000	36.000	0.000	8830.000	1.000	3/25/1992	0.300	1.000	2529.000	724.000
Waukesha	L5790GU	738	r	EngelhardTorvex	c	183.000	3.000	98.400	7641.000	12.000	9/18/1987	0.400	3.454	2199.117	0.000
Waukesha	L5790GU	738	r	EngelhardTorvex	c	164.000	3.000	98.171	18019.000	0.000	11/14/1988	0.100	0.000	5111.159	0.000
Waukesha	L5790GU	738	r	NSCR	c	156.000	1.000	99.400	31722.000	0.000	6/22/1989	0.100	0.000	9020.000	0.000
Waukesha	L5790GU	738	r	Engelhard Cat	c	137.000	0.010	99.800	24700.000	0.000	1/15/1988	0.010	0.000	6976.065	0.000
Waukesha	L5790GU	738	r	NSCR	c	415.000	2.000	100.000	10150.000	0.000	11/17/1989	0.100	0.000	2865.000	0.000
Waukesha	L5790GU	738	r	Engelhard Cat	c	245.000	1.000	99.592	3785.000	0.000	6/23/1988	0.010	0.000	1073.630	0.000
Waukesha	L5790GU	738	r	Engelhard Cat	c	102.000	1.000	99.020	18288.000	58.000	9/9/1988	0.100	0.000	5187.462	0.000
Waukesha	L5790GU	738	r	NSCR	c	328.000	12.000	96.900	9437.000	48.000	8/31/1989	0.100	13.000	2664.000	432.000
Waukesha	L5790GV	738	r	NSCR Engelhard		0.000	29.000	0.000	5454.000	195.000	8/9/1995	0.100	55.000	1547.000	520.000
Waukesha	L5790GV	738	r	EngelhardTorvex		0.000	4.000	0.000	14922.000	10.100	8/24/1994	0.010	2.900	4212.000	551.000
Waukesha	L5790GU	738	r	NSCR	c	0.000	65.000	0.000	6671.000	176.000	3/11/1992	0.100	50.000	1883.000	0.000
Waukesha	L5790GU	738	r	NSCR	c	0.000	17.000	0.000	6855.000	0.000	12/2/1991	0.200	0.000	1935.000	0.000
Waukesha	L5790GU	738	r	NSCR	c	224.000	6.000	97.500	19403.000	0.000	6/20/1990	0.100	0.000	5477.000	0.000
Waukesha	L5790GU	738	r	NSCR		222.000	1.000	0.000	23087.000	0.000	3/17/1988	0.010	0.000	0.000	0.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	34.000	0.000	428.000	90.000	8/18/1993	10.900	53.000	253.000	4203.000
Waukesha	F7042GL	1108	l	Clean Burn		0.000	24.000	0.000	573.000	276.000	7/24/1992	10.500	157.000	325.000	3670.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	36.000	0.000	431.000	206.000	11/15/1989	10.100	113.000	233.000	2008.000
Waukesha	L7042GL	1100	l	Clean Burn	c	59.000	59.000	0.000	582.000	0.000	2/10/1989	9.500	0.000	301.211	2115.000
Waukesha	L7042GL	1100	l	Clean Burn	c	46.000	46.000	0.000	513.000	175.000	6/17/1987	10.000	94.725	277.679	0.000
Waukesha	L7042GL	990	l	Clean Burn	c	47.000	47.000	0.000	516.000	0.000	1/20/1988	0.000	0.000	279.303	0.000
Waukesha	L7042GL	995	l	Clean Burn	c	0.000	79.000	0.000	609.000	0.000	3/31/1988	10.100	0.000	329.642	2306.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	49.000	0.000	603.000	0.000	9/15/1988	9.900	0.000	326.394	2109.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042GL	1108	l	Clean Burn	c	47.000	47.000	0.000	487.000	0.000	9/17/1987	0.000	0.000	263.606	0.000
Waukesha	L7042GL	1117	l	Clean Burn	c	0.000	58.000	0.000	620.000	0.000	7/13/1988	10.200	0.000	335.596	2258.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	90.000	0.000	630.000	0.000	2/15/1990	10.000	0.000	332.000	1933.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	55.000	0.000	606.000	0.000	7/6/1989	10.600	0.000	0.000	2102.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	29.000	0.000	623.000	0.000	8/22/1990	10.200	0.000	344.000	2177.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	37.000	0.000	488.000	242.600	6/21/1991	10.000	131.300	264.000	1960.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	28.000	0.000	563.000	98.000	8/18/1993	9.900	53.000	302.000	4192.000
Waukesha	L7042GL	1100	l	Clean Burn	c	44.000	44.000	0.000	524.000	176.000	6/17/1987	10.200	97.047	288.935	0.000
Waukesha	L7042GL	1051	l	Clean Burn	c	0.000	50.000	0.000	535.000	0.000	7/13/1988	10.400	0.000	295.000	2370.000
Waukesha	L7042GL	1012	l	Clean Burn	c	0.000	50.000	0.000	465.000	0.000	3/31/1988	10.300	0.000	256.402	2447.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	46.000	0.000	496.000	203.000	9/21/1989	9.600	106.000	252.000	1918.000
Waukesha	L7042GL	937	l	Clean Burn	c	131.000	131.000	0.000	572.000	0.000	1/20/1988	0.000	0.000	315.402	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	52.000	0.000	604.000	0.000	9/15/1988	10.600	0.000	333.047	2029.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	61.000	0.000	527.000	0.000	11/15/1989	9.800	0.000	288.000	2074.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	92.000	0.000	570.000	0.000	2/15/1990	9.400	0.000	292.000	2010.000
Waukesha	L7042GL	1129	l	Clean Burn	c	22.000	22.000	0.000	489.000	0.000	9/17/1987	0.000	0.000	269.636	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	58.000	58.000	0.000	541.000	0.000	2/10/1989	9.600	0.000	282.469	2213.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	37.000	0.000	483.000	0.000	7/6/1989	10.800	0.000	0.000	2165.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	13.000	0.000	420.000	78.000	11/4/1992	8.500	37.000	200.000	2516.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	117.000	0.000	501.000	168.000	12/5/1991	9.200	85.000	255.000	1922.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	38.000	0.000	559.000	0.000	5/22/1990	9.800	0.000	287.000	2025.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	46.000	0.000	598.000	179.000	8/22/1990	10.200	99.000	330.000	2140.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	36.000	0.000	488.000	15.000	11/4/1992	9.000	7.000	242.000	2423.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	74.000	0.000	564.000	225.000	10/1/1991	9.800	120.000	300.000	2054.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	47.300	0.000	546.000	118.600	3/27/1987	9.900	0.000	0.000	2186.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	34.000	0.000	550.000	84.000	8/19/1993	10.400	47.000	309.000	3659.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	64.000	0.000	601.000	0.000	12/13/1988	10.400	0.000	0.000	1911.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	39.000	0.000	595.000	210.000	8/23/1994	10.300	117.000	331.000	2349.000
Waukesha	L7042GL	1164	l	Clean Burn	c	125.000	125.000	0.000	484.000	0.000	9/28/1987	0.000	0.000	261.982	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	77.000	0.000	623.000	0.000	7/14/1988	9.900	0.000	337.220	2150.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	53.000	0.000	500.000	0.000	9/20/1989	9.500	0.000	263.000	2001.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	60.000	0.000	588.000	0.000	6/14/1989	9.800	0.000	16.938	1831.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	56.000	0.000	462.000	0.000	11/29/1989	9.600	0.000	248.000	1894.000
Waukesha	L7042GL	959	l	Clean Burn	c	87.000	87.000	0.000	574.000	0.000	1/15/1988	0.000	0.000	310.697	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	46.000	0.000	528.000	204.000	2/27/1990	10.600	117.000	302.000	1992.000
Waukesha	L7042GL	1100	l	Clean Burn	c	47.000	47.000	0.000	427.000	0.000	6/16/1987	0.000	0.000	231.128	0.000
Waukesha	L7042GL	984	l	Clean Burn	c	0.000	98.000	0.000	568.000	198.000	3/31/1988	10.200	109.178	313.196	2236.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042GL	1100	l	Clean Burn	c	45.000	45.000	0.000	517.000	233.000	3/13/1989	10.200	128.477	285.075	1828.000
Waukesha	L7042GL	1100	l	Clean Burn	c	73.000	73.000	0.000	594.000	173.700	3/16/1987	9.700	91.503	312.911	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	63.000	0.000	585.000	0.000	9/21/1988	10.500	0.000	316.651	2248.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	35.000	0.000	438.000	308.000	8/9/1995	10.000	166.000	237.000	1828.000
Waukesha	L7042GL	1108			c	0.000	12.800	0.000	491.100	172.400	7/1/1997	11.220	105.100	299.400	2708.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	43.000	0.000	491.000	83.000	8/19/1993	10.900	49.000	290.000	3297.000
Waukesha	L7042GL	1100	l	Clean Burn	c	54.000	54.000	0.000	554.000	189.600	3/18/1987	10.300	105.532	308.358	0.000
Waukesha	L7042GL	1067	l	Clean Burn	c	98.000	98.000	0.000	508.000	0.000	1/18/1988	0.000	0.000	302.747	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	40.000	40.000	0.000	438.000	0.000	6/16/1987	0.000	0.000	261.030	0.000
Waukesha	L7042GL	987	l	Clean Burn	c	0.000	84.000	0.000	513.000	171.000	3/31/1988	10.200	94.290	282.869	2188.000
Waukesha	L7042GL	1120	l	Clean Burn	c	45.000	45.000	0.000	443.000	0.000	10/8/1987	0.000	0.000	264.010	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	52.000	0.000	530.000	0.000	6/14/1989	9.700	0.000	15.424	1966.000
Waukesha	L7042GL	1100	l	Clean Burn	c	72.000	72.000	0.000	521.000	197.000	3/13/1989	9.500	101.956	269.640	2124.000
Waukesha	L7042GL	1062	l	Clean Burn	c	0.000	63.000	0.000	542.000	0.000	7/14/1988	10.100	0.000	323.010	2067.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	136.000	0.000	610.000	0.000	9/21/1988	10.000	0.000	363.535	2185.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	93.000	0.000	494.000	0.000	11/29/1989	9.500	0.000	256.000	1899.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	85.000	0.000	569.000	0.000	9/20/1989	9.100	0.000	280.000	2021.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	69.000	0.000	592.000	107.000	12/2/1991	9.600	56.000	301.000	1914.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	119.000	0.000	593.000	0.000	6/5/1990	9.200	0.000	292.000	2143.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	31.000	0.000	512.000	0.000	9/5/1990	10.400	0.000	288.000	1973.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	57.000	0.000	491.000	329.000	8/9/1995	10.600	188.000	281.000	1733.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	86.000	0.000	572.000	206.000	8/23/1994	10.200	114.000	315.000	2053.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	46.000	0.000	464.000	60.000	11/4/1992	9.900	32.000	249.000	2174.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	50.000	0.000	611.000	0.000	12/13/1988	10.300	0.000	0.000	2044.000
Waukesha	L7042GL	1108			c	0.000	9.200	0.000	501.500	199.400	7/1/1997	11.330	123.000	309.300	2519.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	41.000	0.000	525.000	99.000	8/19/1993	10.000	54.000	284.000	3883.000
Waukesha	L7042GL	979	l	Clean Burn	c	173.000	173.000	0.000	556.000	0.000	1/18/1988	0.000	0.000	331.354	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	61.000	0.000	525.000	0.000	9/21/1988	10.500	0.000	312.879	2230.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	115.000	0.000	541.000	206.000	11/29/1989	9.700	113.000	275.000	1864.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	48.000	0.000	556.000	0.000	2/27/1990	10.000	0.000	285.000	1945.000
Waukesha	L7042GL	1100	l	Clean Burn	c	44.000	44.000	0.000	520.000	239.400	3/18/1987	10.300	133.251	289.434	0.000
Waukesha	L7042GL	1058	l	Clean Burn	c	84.000	84.000	0.000	450.000	0.000	10/8/1987	0.000	0.000	268.182	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	90.000	90.000	0.000	611.000	0.000	3/13/1989	9.300	0.000	310.767	1983.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	52.000	0.000	480.000	0.000	9/20/1989	9.800	0.000	255.000	2008.000
Waukesha	L7042GL	964	l	Clean Burn	c	0.000	88.000	0.000	507.000	169.000	3/31/1988	10.100	92.324	276.972	2055.000
Waukesha	L7042GL	1100	l	Clean Burn	c	47.000	47.000	0.000	468.000	0.000	6/16/1987	0.000	0.000	278.909	0.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	56.000	0.000	594.000	19.000	11/4/1992	10.200	10.000	328.000	2196.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	57.000	0.000	605.000	0.000	9/5/1990	10.100	0.000	331.000	1980.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	28.000	0.000	147.000	0.000	6/5/1990	9.100	0.000	74.000	1749.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	58.000	0.000	504.000	329.000	8/9/1995	10.300	183.000	281.000	1624.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	34.000	0.000	507.000	179.000	8/23/1994	10.800	105.000	296.000	2663.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	81.000	0.000	603.000	194.000	10/1/1991	9.400	100.000	309.000	1974.000
Waukesha	L7042GL	1108			c	0.000	9.200	0.000	538.000	214.500	7/1/1997	11.060	128.600	322.500	2350.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	42.000	0.000	437.000	132.000	8/18/1993	11.100	80.000	263.000	4728.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	26.000	0.000	542.000	398.000	7/24/1992	11.500	250.000	340.000	2215.000
Waukesha	L7042GL	1100	l	Clean Burn	c	26.000	26.000	0.000	516.000	184.000	6/17/1987	10.100	100.519	281.889	0.000
Waukesha	L7042GL	1007	l	Clean Burn	c	0.000	72.000	0.000	464.000	0.000	3/31/1988	10.000	0.000	251.156	2322.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	37.000	0.000	484.000	0.000	9/21/1989	10.600	0.000	275.000	2094.000
Waukesha	L7042GL	1138	l	Clean Burn	c	71.000	71.000	0.000	471.000	0.000	9/17/1987	0.000	0.000	254.945	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	16.000	0.000	514.000	0.000	3/2/1990	9.800	0.000	268.000	1861.000
Waukesha	L7042GL	1100	l	Clean Burn	c	126.000	126.000	0.000	603.000	0.000	2/10/1989	8.700	0.000	291.615	1966.000
Waukesha	L7042GL	929	l	Clean Burn	c	77.000	77.000	0.000	446.000	0.000	12/17/1987	0.000	0.000	241.413	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	47.000	0.000	448.000	0.000	9/15/1988	10.300	0.000	242.495	2003.000
Waukesha	L7042GL	1048	l	Clean Burn	c	0.000	71.000	0.000	478.000	0.000	7/13/1988	10.100	0.000	258.734	2240.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	80.000	0.000	632.000	0.000	5/22/1990	9.000	0.000	308.000	1734.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	39.000	0.000	404.000	0.000	7/6/1989	11.400	0.000	0.000	2296.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	34.000	0.000	528.000	0.000	8/22/1990	10.200	0.000	291.000	1990.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	67.000	0.000	571.000	184.400	6/21/1991	9.000	91.400	283.000	1795.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	45.000	0.000	545.000	63.000	8/19/1993	10.600	50.000	312.000	3300.000
Waukesha	L7042GL	1100	l	Clean Burn	c	67.000	67.000	0.000	474.000	0.000	6/16/1987	0.000	0.000	282.485	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	42.000	0.000	465.000	0.000	6/14/1989	10.500	0.000	12.502	2056.000
Waukesha	L7042GL	1005	l	Clean Burn	c	104.000	104.000	0.000	500.000	0.000	1/15/1988	0.000	0.000	297.980	0.000
Waukesha	L7042GL	1235	l	Clean Burn	c	55.000	55.000	0.000	451.000	0.000	9/28/1987	0.000	0.000	268.778	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	45.000	45.000	0.000	525.000	287.700	3/16/1987	10.200	158.638	289.486	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	48.000	0.000	404.000	230.000	9/20/1989	10.000	125.000	209.000	2057.000
Waukesha	L7042GL	1100	l	Clean Burn	c	60.000	60.000	0.000	500.000	0.000	3/13/1989	10.200	0.000	275.701	1964.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	104.000	0.000	470.000	0.000	11/29/1989	10.100	0.000	243.000	1958.000
Waukesha	L7042GL	941	l	Clean Burn	c	0.000	92.000	0.000	505.000	187.000	3/31/1988	10.400	105.076	283.762	2169.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	52.000	0.000	476.000	295.000	8/9/1995	10.300	164.000	265.000	1733.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	67.000	0.000	455.000	200.000	10/1/1991	9.100	100.000	288.000	1936.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	54.000	0.000	463.000	20.000	11/4/1992	11.000	12.000	276.000	2641.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	36.000	0.000	466.000	0.000	9/5/1990	10.600	0.000	267.000	2037.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	73.000	0.000	548.000	187.000	8/23/1994	10.200	103.000	302.000	2328.000
Waukesha	L7042GL	1108			c	0.000	6.400	0.000	485.500	197.800	7/1/1997	11.250	121.000	297.000	2691.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	71.000	0.000	499.000	0.000	12/13/1988	10.400	0.000	0.000	1928.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	35.000	0.000	421.000	148.000	8/18/1993	12.400	102.000	292.000	6380.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	46.000	0.000	619.000	330.000	7/24/1992	10.800	193.000	362.000	2553.000
Waukesha	L7042GL	1108	l	Clean Burn		0.000	95.000	0.000	562.000	179.500	6/21/1991	10.000	97.100	304.000	1960.000
Waukesha	L7042GL	1077	l	Clean Burn	c	56.000	56.000	0.000	454.000	0.000	9/17/1987	0.000	0.000	245.743	0.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	39.000	0.000	440.000	0.000	9/21/1989	10.300	0.000	240.000	2128.000
Waukesha	L7042GL	1029	l	Clean Burn	c	90.000	90.000	0.000	490.000	0.000	12/17/1987	0.000	0.000	277.981	0.000
Waukesha	L7042GL	1081	l	Clean Burn	c	0.000	36.000	0.000	537.000	0.000	7/13/1988	10.900	0.000	304.644	2456.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	68.000	0.000	506.000	202.000	11/15/1989	10.000	110.000	271.000	2074.000
Waukesha	L7042GL	941	l	Clean Burn	c	0.000	57.000	0.000	456.000	0.000	3/31/1988	10.700	0.000	258.692	2317.000
Waukesha	L7042GL	1100	l	Clean Burn	c	0.000	50.000	0.000	539.000	0.000	2/27/1990	10.200	0.000	306.000	2109.000
Waukesha	L7042GL	1100	l	Clean Burn	c	77.000	77.000	0.000	533.000	0.000	2/10/1989	9.200	0.000	268.778	1983.000
Waukesha	L7042GL	1100	l	Clean Burn	c	36.000	36.000	0.000	486.000	170.000	6/17/1987	10.200	93.738	267.981	0.000
Waukesha	L7042GL	1108	l	Clean Burn	c	0.000	42.000	0.000	534.000	0.000	5/22/1990	10.000	0.000	281.000	2087.000
Waukesha	F1197GU	150	r	NSCR		100.000	2.000	0.000	24765.000	30.000	11/28/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	Catalyst	c	351.000	17.000	95.200	9700.000	23.400	10/28/1986	0.010	6.609	2739.588	0.000
Waukesha	F1197GU	150	r	JM Denox 250	c	62.000	20.000	67.700	5949.000	10.000	1/19/1988	3.300	3.352	1994.267	0.000
Waukesha	F1197GU	150	r	JM Denox	c	0.000	31.000	0.000	0.000	0.000	7/29/1993	1.500	96.900	3724.000	45.000
Waukesha	F1197GU	150	r	NSCR		71.000	11.000	83.900	0.000	0.000	6/27/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		100.000	48.000	52.100	1152.000	0.000	7/2/1991	0.600	0.000	325.000	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	141.000	13.000	90.780	34978.000	0.000	3/30/1988	0.010	0.000	9969.575	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	271.000	15.000	94.000	13510.000	89.000	11/30/1989	0.700	26.000	3946.000	185.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	76.000	35.000	53.947	49476.000	0.000	9/8/1988	0.200	0.000	14101.860	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	168.000	7.000	95.833	43173.000	0.000	2/14/1989	0.200	0.000	12305.350	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	205.000	5.000	97.700	11869.000	0.000	9/8/1989	0.600	0.000	3450.000	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	102.000	11.000	87.000	18600.000	0.000	6/19/1989	1.100	0.000	5556.000	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	35.000	20.000	42.900	50747.000	0.000	2/19/1987	0.000	0.000	14332.570	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey		39.000	20.000	48.700	24553.000	0.000	6/11/1987	0.000	0.000	7664.693	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	221.000	13.000	94.100	5769.000	0.000	9/30/1987	0.000	0.000	1629.349	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	0.000	41.000	0.000	14019.000	0.000	2/28/1990	0.700	0.000	3958.000	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	194.000	31.000	84.000	12042.000	0.000	8/29/1990	0.800	0.000	3399.000	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	0.000	27.000	0.000	2317.000	408.000	6/5/1992	4.000	142.000	809.000	55.000
Waukesha	F1197GU	150	r	JM NSCR	c	201.000	31.000	84.500	14958.000	0.000	5/21/1990	1.000	0.000	4435.000	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	0.000	18.000	0.000	6154.000	30.000	12/10/1991	0.700	9.000	1797.000	45.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	265.000	5.000	98.100	20549.000	24.000	1/19/1988	0.100	6.808	5828.803	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	0.000	36.000	0.000	7576.000	0.000	7/29/1993	1.900	609.200	2353.000	35.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	486.000	19.000	96.091	9958.000	0.000	2/14/1989	0.100	0.000	2824.625	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F1197GU	150	r	Englehard NSCR	c	101.000	12.000	88.300	29742.000	0.000	11/30/1989	0.300	0.000	8396.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	142.000	30.000	78.873	42196.000	0.000	9/8/1988	0.100	0.000	11969.060	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	247.000	28.000	89.000	30462.000	0.000	6/19/1989	0.100	0.000	8662.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	0.000	10.000	0.000	4733.000	22.000	2/28/1990	0.100	6.000	1560.000	271.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	236.000	35.000	85.169	27802.000	0.000	3/30/1988	0.010	0.000	7924.242	0.000
Waukesha	F1197GU	150	r	NSCR		0.000	3.000	0.000	1796.000	80.000	7/2/1991	0.200	23.000	512.000	1851.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	304.000	14.000	95.500	15516.000	0.000	5/21/1990	0.100	0.000	4380.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	303.000	16.000	94.700	8589.000	0.000	8/29/1990	0.100	0.000	2425.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	0.000	45.000	0.000	2607.000	710.000	6/5/1992	2.400	133.000	831.000	50.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	0.000	14.000	0.000	1619.000	0.000	12/10/1991	1.000	0.000	480.000	0.000
Waukesha	F1197GU	150	r	NSCR		134.000	15.000	88.900	0.000	0.000	6/27/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		319.000	10.000	0.000	14012.000	20.000	11/28/1988	0.300	0.000	0.000	0.000
Waukesha	F1197GU	150	r	JM Denox 250	c	87.000	35.000	59.800	22784.000	131.000	1/19/1988	0.900	38.645	6721.280	0.000
Waukesha	F1197GU	150	r	Catalyst	c	572.000	29.000	94.900	8000.000	23.200	10/28/1986	0.010	6.552	2259.454	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	79.000	19.000	77.000	8213.000	0.000	6/19/1989	3.600	0.000	2807.000	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	107.000	23.000	78.500	8487.000	0.000	9/30/1987	0.000	0.000	2396.999	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	120.000	16.000	86.667	31722.000	22.300	2/17/1989	0.400	6.418	9129.746	324.000
Waukesha	F1197GU	150	r	JM NSCR	c	75.000	12.000	84.600	35305.000	0.000	9/8/1989	0.100	0.000	10014.000	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	119.000	32.000	73.109	45003.000	0.000	3/30/1988	0.010	0.000	12826.940	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	117.000	12.000	89.744	26907.000	0.000	9/8/1988	0.300	0.000	7706.374	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey	c	64.000	34.000	46.900	32750.000	0.000	2/19/1987	0.000	0.000	9249.641	0.000
Waukesha	F1197GU	150	r	JohnsonMatthey		63.000	27.000	57.100	16721.000	0.000	6/11/1987	0.000	0.000	5219.783	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	106.000	5.000	94.800	15652.000	0.000	5/21/1990	0.400	0.000	4505.000	0.000
Waukesha	F1197GU	150	r	NSCR		199.000	16.000	92.200	10458.000	0.000	7/2/1991	1.000	0.000	2952.000	0.000
Waukesha	F1197GU	150	r	JM NSCR	c	88.000	7.000	91.600	5907.000	72.000	8/29/1990	5.500	28.000	2263.000	274.000
Waukesha	F1197GU	150	r	JM NSCR	c	0.000	35.000	0.000	813.000	349.000	6/5/1992	5.400	133.000	309.000	60.000
Waukesha	F1197GU	150	r	JM NSCR	c	36.000	9.000	75.600	7677.000	9.000	12/13/1991	4.100	3.000	2696.000	125.000
Waukesha	F1197GU	150	r	NSCR		69.000	18.000	73.400	0.000	0.000	6/27/1988	0.010	0.000	0.000	0.000
Clark	HRA-32	350	l	None	m	194.000	0.000	0.000	176.000	122.000	12/6/1990	14.430	2.387	160.000	1126.000
Clark	HRA-32	350	l	SCR	m	249.000	50.000	0.000	352.000	0.000	7/1/1988	14.600	0.000	0.000	0.000
Clark	HRA-32	350	l	catalyst	m	220.000	67.000	69.500	485.000	0.000	4/28/1986	0.000	0.000	485.000	0.000
Clark	HRA-32	350	l	SCR	m	221.000	69.000	0.000	345.000	248.000	11/28/1988	14.700	0.000	0.000	2598.000
Clark	HRA-32	350	l	Englehard SCR	m	161.000	55.000	67.000	190.000	0.000	6/16/1989	14.200	0.000	167.000	0.000
Clark	HRA-32	350	l	EngelhardTorvex	m	199.000	61.000	69.347	374.000	0.000	3/15/1989	14.800	0.000	361.738	0.000
Clark	HRA-32	350	l	Torvex Cat	m	303.000	63.000	79.208	273.000	0.000	3/18/1988	14.700	0.000	273.000	0.000
Clark	HRA-32	350	l	Torvex Cat	m	238.000	39.000	83.600	410.000	269.700	12/17/1986	13.100	204.004	310.128	0.000
Clark	HRA-32	350	l	SCR	m	259.000	90.000	65.300	460.000	0.000	8/27/1986	0.000	0.000	460.000	0.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Clark	HRA-32	350	l	Torvex	m	293.000	52.000	82.300	208.000	0.000	6/11/1987	0.000	0.000	208.000	0.000
Clark	HRA-32	350	l	Torvex Cat	m	556.000	111.000	80.000	214.000	0.000	10/8/1987	0.000	0.000	214.000	0.000
Clark	HRA-32	350	l	Torvex	m	373.000	111.000	70.200	450.000	537.000	12/15/1987	14.200	472.881	396.269	0.000
Clark	HRA-32	350	l	Torvex	m	211.000	50.000	76.300	289.000	0.000	2/26/1987	0.000	0.000	289.000	0.000
Clark	HRA-32	350	l	Englehard SCR	m	336.000	100.000	70.200	452.000	0.000	10/30/1989	12.700	0.000	325.000	0.000
Clark	HRA-32	350	l	EngelhardTorvex	m	314.000	75.000	76.115	365.000	0.000	9/9/1988	14.900	0.000	358.917	0.000
Clark	HRA-32	350	l	None	m	373.000	0.000	0.000	216.000	132.000	12/6/1990	15.280	2.439	227.000	1320.000
Clark	HRA-32	350	l	None	m	992.000	0.000	0.000	438.000	139.000	12/6/1990	14.460	2.714	401.000	1572.000
Clark	HRA-32	350	l	None	m	243.000	0.000	0.000	164.000	0.000	5/26/1989	13.900	0.000	138.000	0.000
Clark	HRA-32	350	l	None	m	79.000	0.000	0.000	209.000	90.000	12/6/1990	15.010	1.693	209.000	1032.000
Ingersoll-Rand	SVG-6	330	r	catalyst	m	266.000	20.000	92.500	19899.000	28.100	3/20/1986	0.200	8.009	5671.696	0.000
Ingersoll-Rand	SVG-6	330	r	catalyst	m	236.000	10.000	95.800	16646.000	0.000	6/9/1986	0.000	0.000	4767.544	0.000
Ingersoll-Rand	SVG-6	330	r	Torvex	m	412.000	13.000	96.800	8812.000	0.000	9/29/1987	0.000	0.000	2523.825	0.000
Ingersoll-Rand	SVG-6	330	r	JMI NSCR	m	168.000	10.000	94.300	21475.000	0.000	9/7/1989	0.500	0.000	6211.000	0.000
Ingersoll-Rand	SVG-6	330	r	Torvex	m	176.000	8.000	95.500	25400.000	0.000	8/27/1986	0.000	0.000	7274.757	0.000
Ingersoll-Rand	SVG-6	330	r	EngelhardTorvex	m	332.000	7.000	97.892	11596.000	0.000	2/14/1989	0.200	0.000	3305.140	0.000
Ingersoll-Rand	SVG-6	330	r	Torvex	m	242.000	4.000	98.300	17600.000	20.600	12/10/1986	0.010	5.818	4970.799	0.000
Ingersoll-Rand	SVG-6	330	r	JMI NSCR	m	417.000	11.000	97.400	1166.000	0.000	2/22/1990	6.700	0.000	329.000	0.000
Ingersoll-Rand	SVG-6	330	r	EngelhardTorvex	m	318.000	16.000	94.969	14257.000	0.000	2/18/1988	0.600	0.000	4083.316	0.000
Ingersoll-Rand	SVG-6	330	r	EngelhardTorvex	m	326.000	20.000	93.865	27066.000	0.000	8/23/1988	0.100	0.000	7677.375	0.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	201.000	5.000	97.500	12249.000	0.000	6/10/1987	0.000	0.000	3459.507	0.000
Ingersoll-Rand	SVG-6	330	r	Torvex	m	562.000	10.000	98.200	2757.000	22.000	12/15/1987	0.300	6.301	789.626	0.000
Ingersoll-Rand	SVG-6	330	r	Torvex	m	227.000	5.000	97.800	17381.000	0.000	2/26/1987	0.000	0.000	4978.053	0.000
Ingersoll-Rand	SVG-6	330	r	JMI NSCR	m	245.000	10.000	95.900	10950.000	24.000	5/15/1990	1.900	7.000	3400.000	419.000
Ingersoll-Rand	SVG-6	330	r	JMI NSCR	m	319.000	6.000	98.200	7996.000	29.000	10/19/1990	0.100	9.000	2395.000	387.000
Ingersoll-Rand	SVG-6	330	r	NSCR		579.000	20.000	97.000	5051.000	0.000	11/17/1988	0.300	0.000	0.000	0.000
Ingersoll-Rand	SVG-6	330	r	NSCR		259.000	38.000	85.200	0.000	0.000	6/10/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-6	330	r	catalyst	m	372.000	19.000	94.900	1299.000	2.600	4/7/1986	0.100	0.738	368.466	0.000
Ingersoll-Rand	SVG-6	330	r	catalyst	m	355.000	7.000	98.000	8409.000	0.000	6/9/1986	0.000	0.000	2385.245	0.000
Ingersoll-Rand	SVG-6	330	r	NSCR	m	322.000	15.000	97.700	16204.000	0.000	11/30/1989	0.100	0.000	4574.000	0.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	342.000	6.000	98.200	4562.000	0.000	6/10/1987	0.000	0.000	1294.029	0.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	433.000	2.000	99.500	9383.000	22.200	3/19/1987	0.010	6.270	2650.057	0.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	177.000	3.000	98.300	9440.000	0.000	9/29/1987	0.000	0.000	2677.692	0.000
Ingersoll-Rand	SVG-6	330	r	JM NSCR	m	142.000	10.000	93.000	24662.000	0.000	6/15/1989	0.500	0.000	7105.000	0.000
Ingersoll-Rand	SVG-6	330	r	EngelhardTorvex	m	263.000	3.000	98.859	8489.000	14.600	2/17/1989	0.100	4.141	2407.938	140.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	358.000	4.000	98.883	9005.000	23.000	2/18/1988	0.010	6.524	2554.303	357.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatteny	m	372.000	1.000	99.700	11800.000	0.000	12/17/1986	0.000	0.000	3347.115	0.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	373.000	21.000	94.400	1040.000	0.000	12/15/1987	0.000	0.000	295.000	0.000
Ingersoll-Rand	SVG-6	330	r	NSCR	m	251.000	2.000	99.200	20300.000	0.000	8/28/1986	0.000	0.000	5758.173	0.000
Ingersoll-Rand	SVG-6	330	r	JohnsonMatthey	m	207.000	2.000	99.034	19110.000	0.000	8/23/1988	0.100	0.000	5420.625	0.000
Ingersoll-Rand	SVG-6	330	r	JMI NSCR	m	307.000	11.000	96.500	9092.000	0.000	10/3/1990	0.100	0.000	2567.000	0.000
Ingersoll-Rand	SVG-6	330	r	NSCR		195.000	1.000	99.600	17462.000	0.000	11/17/1988	0.100	0.000	0.000	0.000
Ingersoll-Rand	SVG-6	330	r	NSCR		261.000	5.000	98.300	0.000	0.000	6/10/1988	0.400	0.000	0.000	0.000
Waukesha	145GKU	90	r	EngelhardTorvex	d	312.000	2.000	99.400	9032.000	64.000	11/12/1987	0.300	18.330	2586.835	61.000
Waukesha	145GKU	65	r	EngelhardTorvex	d	389.000	1.000	99.743	5192.000	0.000	2/18/1988	0.010	0.000	1487.029	0.000
Waukesha	145GKU	90	r	Englehard	d	99.000	5.000	95.200	30485.000	149.000	9/7/1989	0.100	42.000	8606.000	247.000
Waukesha	145GKU	90	r	Englehard	d	517.000	5.000	99.000	5477.000	0.000	6/15/1989	0.100	0.000	1550.000	0.000
Waukesha	145GKU	90	r	Englehard NSCR	d	174.000	8.000	95.100	11427.000	0.000	5/14/1990	0.100	0.000	3226.000	0.000
Waukesha	145GKU	90	r	Englehard NSCR	d	143.000	3.000	97.900	5322.000	0.000	10/3/1990	0.100	0.000	1502.000	0.000
Waukesha	145GKU	90	r	NSCR		448.000	11.000	97.400	9288.000	0.000	11/17/1988	0.010	0.000	0.000	0.000
Waukesha	145GKU	90	r	EngelhardTorvex	d	386.000	6.000	98.400	531.000	6.000	11/12/1987	0.010	1.695	149.971	64.000
Waukesha	145GKU	90	r	EngelhardTorvex	d	515.000	31.000	93.981	7288.000	50.800	2/17/1989	0.100	14.410	2067.269	92.000
Waukesha	145GKU	90	r	Englehard	d	404.000	28.000	93.000	15454.000	0.000	6/15/1989	0.100	0.000	4373.000	0.000
Waukesha	145GKU	90	r	Englehard	d	465.000	26.000	94.500	10377.000	0.000	9/15/1989	0.100	0.000	2929.000	0.000
Waukesha	145GKU	90	r	Englehard	d	430.000	16.000	96.200	15216.000	0.000	12/1/1989	0.100	0.000	4295.000	0.000
Waukesha	145GKU	90	r	Engelhard	d	561.000	42.000	92.500	5596.000	28.000	2/22/1990	0.300	8.000	1603.000	260.000
Waukesha	145GKU	65	r	EngelhardTorvex	d	457.000	19.000	95.842	1373.000	0.000	2/18/1988	0.010	0.000	389.457	0.000
Waukesha	145GKU	90	r	EngelhardTorvex	d	421.000	9.000	97.862	1973.000	0.000	8/23/1988	0.100	0.000	559.649	0.000
Waukesha	145GKU	90	r	NSCR	d	319.000	16.000	94.900	0.000	0.000	6/10/1988	0.100	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		91.000	47.000	48.900	0.000	0.000	6/10/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		151.000	6.000	0.000	25556.000	0.000	12/15/1988	0.400	0.000	0.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	747.000	39.000	94.800	3913.000	39.000	11/10/1987	0.010	11.015	1105.156	134.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	0.000	22.000	0.000	5635.000	0.000	7/29/1993	0.900	120.300	1662.000	26.000
Waukesha	F1197GU	150	r	EnglehardTorvex	c	102.000	7.000	93.137	34192.000	0.000	1/31/1989	0.100	0.000	9698.692	0.000
Waukesha	F1197GU	98	r	EngelhardTorvex	c	146.000	44.000	69.863	37144.000	0.000	2/17/1988	0.010	0.000	10848.990	0.000
Waukesha	F1197GU	150	r	Englehard	c	177.000	25.000	85.600	41128.000	0.000	11/16/1989	0.300	0.000	11610.000	0.000
Waukesha	F1197GU	150	r	Englehard	c	95.000	3.000	97.300	42908.000	121.000	9/7/1989	0.200	35.000	12230.000	155.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	90.000	33.000	63.333	46981.000	155.000	8/22/1988	0.700	45.272	13722.170	208.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	154.000	29.000	81.000	36554.000	0.000	2/20/1990	0.100	0.000	10319.000	0.000
Waukesha	F1197GU	150	r	Englehard	c	104.000	23.000	79.000	40004.000	0.000	6/8/1989	0.700	0.000	11712.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	0.000	4.000	0.000	944.000	552.000	6/4/1992	4.100	194.000	332.000	54.000
Waukesha	F1197GU	150	r	Englehard	c	190.000	47.000	75.400	13723.000	133.000	12/13/1991	0.200	38.000	3911.000	101.000
Waukesha	F1187GU	150	r	JM NSCR	c	225.000	15.000	93.300	15118.000	0.000	5/15/1990	0.100	0.000	4288.000	0.000
Waukesha	F1197GU	150	r	Englehard	c	0.000	2.000	0.000	1596.000	13.000	12/10/1991	0.100	4.000	453.000	45.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F1197GU	150	r	Englehard NSCR	c	489.000	11.000	97.900	1386.000	12.000	10/3/1990	0.100	3.000	391.000	165.000
Waukesha	F1197GU	150	r	EngelhardTorvex		449.000	17.000	96.200	11389.000	19.000	11/10/1987	0.010	5.366	3216.616	119.000
Waukesha	F1197GU	150	r	Englehard	c	31.000	9.000	68.000	41520.000	0.000	6/8/1989	0.500	0.000	12037.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	33.000	18.000	45.455	43474.000	272.000	8/22/1988	0.200	77.527	12391.140	308.000
Waukesha	F1197GU	98	r	EngelhardTorvex	c	488.000	8.000	98.361	5562.000	0.000	2/17/1988	0.010	0.000	1577.683	0.000
Waukesha	F1197GU	150	r	Englehard	c	40.000	18.000	55.300	64198.000	0.000	11/16/1989	0.100	0.000	18123.000	0.000
Waukesha	F1197GU	150	r	EnglehardTorvex	c	98.000	3.000	96.939	24949.000	0.000	1/31/1989	0.100	0.000	7076.880	0.000
Waukesha	F1197GU	150	r	Englehard	c	39.000	11.000	71.300	45385.000	146.000	9/7/1989	0.100	41.000	12812.000	231.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	117.000	36.000	69.700	19385.000	0.000	2/20/1990	0.100	0.000	5472.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	565.000	35.000	93.900	7025.000	28.000	10/11/1990	0.200	11.000	2002.000	222.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	62.000	38.000	38.100	35199.000	0.000	5/14/1990	0.200	0.000	10033.000	0.000
Waukesha	F1197GU	150	r	NSCR		96.000	3.000	0.000	25673.000	0.000	12/15/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		287.000	34.000	88.200	0.000	0.000	6/10/1988	0.010	0.000	0.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex		479.000	3.000	99.400	12239.000	10.000	11/10/1987	0.700	2.921	3574.757	131.000
Waukesha	F1197GU	150	r	Englehard	c	90.000	17.000	81.100	40411.000	323.000	9/7/1989	0.100	91.000	11408.000	173.000
Waukesha	F1197GU	150	r	Englehard	c	90.000	33.000	63.600	55231.000	0.000	11/16/1989	0.100	0.000	15592.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	436.000	27.000	93.807	9000.000	0.000	2/14/1989	0.100	0.000	2552.885	0.000
Waukesha	F1197GU	98	r	EngelhardTorvex	c	211.000	34.000	83.886	24920.000	0.000	2/17/1988	0.010	0.000	7102.802	0.000
Waukesha	F1197GU	150	r	Englehard	c	355.000	6.000	98.000	10133.000	0.000	6/8/1989	0.100	0.000	2867.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	68.000	48.000	30.200	36891.000	0.000	2/20/1990	0.600	0.000	10414.000	0.000
Waukesha	F1197GU	150	r	EngelhardTorvex	c	231.000	14.000	93.939	31471.000	136.000	8/22/1988	0.100	38.577	8926.870	136.000
Waukesha	F1197GU	150	r	Englehard	c	190.000	8.000	95.700	13342.000	0.000	5/15/1990	0.100	0.000	3785.000	0.000
Waukesha	F1197GU	150	r	Englehard NSCR	c	481.000	18.000	96.200	2702.000	48.000	10/11/1990	0.200	14.000	770.000	86.000
Waukesha	F1197GU	150	r	NSCR		36.000	27.000	19.700	0.000	0.000	6/10/1988	0.100	0.000	0.000	0.000
Waukesha	F1197GU	150	r	NSCR		195.000	25.000	0.000	24961.000	0.000	11/17/1988	0.010	0.000	0.000	0.000
Ingersoll-Rand	SVG-8	440	r	ECS Cat Convert		358.000	1.000	99.700	2495.000	17.000	12/18/1987	0.010	4.801	704.667	356.000
Caterpillar	G-3306	195	r	Engelhardt NSCC	d	370.000	35.000	90.500	11589.000	26.000	4/21/1987	0.001	7.340	3273.102	0.000
Ingersoll-Rand	SVG-8	440	r	NSCR	m	240.000	0.500	99.583	16223.000	55.000	9/18/1989	0.100	15.000	4580.000	343.000
Ingersoll-Rand	SVG-8	440	r	NSCR	m	519.000	30.000	94.200	3062.000	35.600	2/6/1989	0.010	10.049	864.392	277.000
Enterprise	GSG-6	465	r	LoNOx Cat Conv		0.000	31.000	0.000	8884.000	212.000	12/17/1993	0.100	60.000	2520.000	506.000
Enterprise	GSG-6	465	r	LoNOx 43N-10 CC	c	29.000	2.000	93.100	39248.000	153.000	4/15/1987	0.100	43.399	11132.850	0.000
Enterprise	GSG-6	465	r	NSCR		0.000	14.000	0.000	11980.000	25.000	12/9/1994	0.100	7.000	3398.000	467.000
Enterprise	GSG-6	465	r	NSCR		0.000	21.000	0.000	2602.000	54.000	12/14/1992	0.100	15.000	738.000	456.000
Enterprise	GSG-6	465	r	LONOx Cat Conv	c	39.000	1.000	97.400	45265.000	0.000	6/15/1988	1.000	0.000	12839.590	447.000
Enterprise	GSG-6	465	r	ESC NSCR	c	93.000	1.000	98.500	67445.000	70.000	10/26/1989	0.400	20.000	22230.000	884.000
Enterprise	GSG-6	465	r	ESC NSCR	c	361.000	5.000	98.700	13047.000	22.000	11/21/1990	1.000	6.000	3868.000	950.000
Enterprise	GSG-6	465	r	LONOx Cat Conv	c	0.000	17.000	0.000	11015.000	0.000	9/16/1992	0.700	0.000	3225.000	0.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Enterprise	GSG-6	465	r	ESC NSCR	c	0.000	17.000	0.000	7727.000	1.000	3/13/1992	0.300	1.000	2213.000	485.000
Enterprise	GSG-6	465	r	NSCR - ECS	c	0.000	14.000	0.000	12518.000	2.200	12/10/1996	0.100	0.600	3585.000	432.000
Enterprise	GSM-6	550	r	NSCR		0.000	23.000	0.000	12461.000	6.000	4/8/1992	0.300	2.000	4107.000	427.000
Enterprise	GSG-6	520	r	ECS LoNox CC	c	561.000	3.000	99.500	6360.000	30.200	1/14/1987	0.100	8.566	1804.038	0.000
Enterprise	GSG-6	520	r	ECS LowNOx CC		0.000	21.000	0.000	10986.000	387.000	3/11/1993	0.100	110.000	3116.000	405.000
Enterprise	GSG-6	520	r	NSCR		0.000	9.000	0.000	4951.000	52.000	3/27/1995	0.100	15.000	1404.000	464.000
Enterprise	GSG-6	520	r	ECS LowNOx CC		0.000	6.000	0.000	3155.000	17.000	3/14/1994	0.100	5.000	895.000	432.000
Enterprise	GSG-6	520	r	ESC NSCR	c	625.000	29.000	95.400	3661.000	31.000	10/25/1989	0.200	9.000	1043.000	364.000
Enterprise	GSG-6	520	r	ESC LoNOx CC	c	674.000	12.000	98.489	7478.000	45.000	12/27/1988	0.200	12.826	0.000	456.000
Enterprise	GSG-6	520	r	ESC NSCR	c	457.000	22.000	95.100	7831.000	65.000	11/20/1990	0.200	18.000	2232.000	365.000
Enterprise	GSG-6	520	r	ESC LoNOx CC	c	0.000	37.000	0.000	4219.000	0.000	9/18/1992	0.300	0.000	1232.000	0.000
Enterprise	GSG-6	500	r	NSCR - ECS		0.000	8.000	0.000	4938.000	65.000	3/13/1996	0.010	18.000	1394.000	395.000
Enterprise	GSG-6	500	r	NSCR	c	0.000	17.000	0.000	13827.000	39.000	3/14/1997	0.010	11.000	3903.000	439.000
Enterprise	GSG-6	500	r	NSCR - ECS	c	0.000	23.000	0.000	7422.000	0.000	12/23/1996	0.010	0.000	2100.000	0.000
Enterprise	GSG-6	520	r	ECS LowNox CC		0.000	15.000	0.000	11375.000	86.000	3/11/1993	0.100	24.600	3227.000	400.000
Enterprise	GSG-6	520	r	ECS LoNox CC	c	237.000	2.000	99.200	33400.000	81.400	12/30/1986	0.100	23.089	9474.038	0.000
Enterprise	GSG-6	530	r	ECS LoNOx CC		0.000	15.000	0.000	10641.000	21.000	3/14/1994	0.100	6.000	3018.000	432.000
Enterprise	GSM-6	550	r	NSCR		0.000	47.000	0.000	10465.000	157.000	4/8/1992	0.100	45.000	2968.000	422.000
Enterprise	GSG-6	520	r	ESC LoNOx CC	c	317.000	16.000	94.953	15164.000	110.900	3/28/1989	0.500	32.074	4385.667	487.000
Enterprise	GSG-6	520	r	ESC NSCR	c	325.000	22.000	93.200	16836.000	105.000	10/25/1989	0.300	30.000	4822.000	479.000
Enterprise	GSG-6	520	r	NSCR		0.000	8.000	0.000	6984.000	122.000	3/27/1995	0.100	34.000	1972.000	436.000
Enterprise	GSG-6	520	r	ESC LoNOx CC	c	0.000	19.000	0.000	14581.000	0.000	9/18/1992	0.100	0.000	4146.000	0.000
Enterprise	GSG-6	520	r	ESC NSCR	c	611.000	19.000	96.900	5885.000	2.000	11/27/1990	0.010	1.000	1763.000	500.000
Enterprise	GSG-6	500	r	NSCR - ECS	c	0.000	33.000	0.000	13761.000	0.000	12/23/1996	0.010	0.000	3894.000	0.000
Enterprise	GSG-6	520	r	NSCR	c	0.000	12.000	0.000	12440.000	74.000	3/14/1997	0.010	21.000	3512.000	433.000
Enterprise	GSG-6	520	r	NSCR - ECS		0.000	48.000	0.000	5879.000	110.000	3/13/1996	0.100	31.000	1668.000	466.000
Enterprise	GSM-8	300	r	LoNOx 43N-10 CC		0.000	20.000	0.000	139.000	139.000	3/14/1994	0.100	39.000	39.000	215.000
Enterprise	GSM-8	300	r	LoNOx 43N-10 CC	c	131.000	2.000	98.500	38839.000	103.000	4/22/1987	0.200	29.357	11070.050	0.000
Enterprise	GSG-8	300	r	LoNOx 43N-10 CC		0.000	34.000	0.000	9962.000	386.000	3/11/1993	0.050	109.000	2819.000	218.000
Enterprise	GSM-8	300	r	NSCR		0.000	8.000	0.000	10160.000	467.000	3/27/1995	0.400	134.000	2924.000	348.000
Enterprise	GSM-8	300	r	ESC NSCR	c	428.000	35.000	91.700	41247.000	200.000	10/27/1989	0.100	57.000	11644.000	115.000
Enterprise	GSM-8	300	r	LONOx Cat Conv	c	33.000	7.000	78.800	50049.000	0.000	6/16/1988	0.100	0.000	14265.170	427.000
Enterprise	GSM-8	300	r	LoNOx 43N-10 CC	c	0.000	30.000	0.000	15622.000	0.000	9/16/1992	0.100	0.000	4442.000	0.000
Enterprise	GSM-8	300	r	ESC NSCR	c	367.000	1.000	99.700	11170.000	182.000	12/11/1990	0.010	51.000	3153.000	114.000
Enterprise	GSM-8	300	r	ESC NSCR	c	0.000	36.000	0.000	4929.000	146.000	5/1/1992	0.100	41.000	1398.000	187.000
Enterprise	GSM-8	300	r	NSCR	c	0.000	16.000	0.000	5140.000	20.000	3/14/1997	0.010	5.700	1451.000	341.000
Enterprise	GSG-8	300	r	NSCR - ECS	c	0.000	42.000	0.000	12941.000	0.000	12/23/1996	0.100	0.000	3662.000	0.000

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MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Enterprise	GSM-8	300	r	NSCR - ECS		0.000	9.000	0.000	5030.000	443.000	3/13/1996	0.010	125.000	1420.000	298.000
Caterpillar	G-398	420	r	NSCR		0.000	10.000	0.000	9621.000	142.000	6/29/1994	0.010	40.000	2716.000	503.000
Caterpillar	G-398	420	r	HIS Corp	c	152.000	1.000	99.300	35820.000	83.200	3/30/1987	0.010	23.498	10116.710	331.000
Caterpillar	G-398	420	r	HIS NSCR	c	0.000	5.000	0.000	4200.000	13.000	6/24/1993	0.100	4.000	1191.000	485.000
Caterpillar	G-398	420	r	NSCR HIS		0.000	32.000	0.000	7386.000	170.000	8/2/1995	0.500	49.000	2138.000	439.000
Caterpillar	G-398	420	r	Houston NSCR	c	606.000	29.000	95.215	9679.000	0.000	12/27/1989	0.100	0.000	2732.000	0.000
Caterpillar	G-398	420	r	Houston NSCR	c	0.000	3.000	0.000	580.000	1.000	4/7/1992	0.100	1.000	165.000	484.000
Caterpillar	G-398	420	r	Houston NSCR	c	0.000	2.000	0.000	4140.000	1.000	6/10/1992	0.100	1.000	2001.000	525.000
Caterpillar	G-398	420	r	HIS NSCR		312.000	3.400	0.000	0.000	0.000	6/23/1987	0.100	0.000	0.000	404.000
Caterpillar	G-398	420	r	NSCR		539.000	17.000	0.000	13521.000	0.000	4/24/1991	0.100	0.000	3817.000	0.000
Caterpillar	G-398	420	r	Houston NSCR	c	603.000	7.000	98.800	4067.000	60.000	9/6/1990	0.100	17.000	1148.000	383.000
Caterpillar	G-398	420	r	NSCR	c	0.000	5.000	0.000	4742.000	2.500	7/25/1996	0.100	0.070	1340.000	434.000
Caterpillar	G-398	420	r	NSCR		0.000	3.000	0.000	14917.000	7.200	8/27/1997	0.001	2.000	4211.000	464.000
Caterpillar	G-398	420	r	HIS NSCR	c	0.000	7.000	0.000	5472.000	14.000	6/24/1993	0.100	4.000	1552.000	485.000
Caterpillar	G-398	420	r	HIS Corp	c	402.000	13.000	96.800	20650.000	59.000	3/30/1987	0.300	16.898	5914.320	336.000
Caterpillar	G-398	420	r	HIS Corp DN/C	c	331.000	18.000	94.600	23950.000	121.000	4/14/1988	0.010	34.174	6764.241	1047.000
Caterpillar	G-398	420	r	NSCR		0.000	22.000	0.000	4143.000	66.000	11/13/1991	0.100	19.000	1175.000	182.000
Caterpillar	G-398	420	r	Houston NSCR	c	300.000	41.000	86.333	25643.000	0.000	12/27/1989	0.100	0.000	7239.000	0.000
Caterpillar	G-398	420	r	HIS Corp	c	315.000	10.000	96.825	19111.000	113.000	5/11/1989	0.010	32.053	5408.000	449.000
Caterpillar	G-398	420	r	NSCR HIS		0.000	12.000	0.000	12377.000	145.000	8/2/1995	0.400	42.000	3562.000	438.000
Caterpillar	G-398	420	r	NSCR		348.000	21.000	0.000	13172.000	155.000	4/24/1991	0.100	44.000	3736.000	279.000
Caterpillar	G-398	420	r	Houston NSCR	c	312.000	45.000	85.700	21471.000	108.000	5/4/1990	0.100	31.000	6074.000	495.000
Caterpillar	G-398	420	r	Houston NSCR	c	0.000	13.000	0.000	3469.000	1.000	6/10/1992	1.200	1.000	1039.000	554.000
Caterpillar	G-398	420	r	NSCR		0.000	16.000	0.000	1537.000	97.000	6/29/1994	0.100	27.000	434.000	503.000
Caterpillar	G-398	420	r	NSCR		0.000	43.000	0.000	4238.000	9.500	8/27/1997	0.001	2.700	1196.000	607.000
Caterpillar	G-398	420	r	NSCR	c	0.000	36.000	0.000	13139.000	92.000	7/25/1996	0.010	26.000	3709.000	648.000
Caterpillar	G-398	420	r	HIS NSCR	c	0.000	14.000	0.000	9281.000	40.000	6/24/1993	0.100	11.000	2633.000	485.000
Caterpillar	G-398	420	r	HIS Corp DN/C	c	277.000	16.000	94.200	24270.000	152.000	4/14/1988	0.010	42.930	6854.619	349.000
Caterpillar	G-398	420	r	NSCR		0.000	13.000	0.000	2835.000	181.000	7/17/1991	0.100	52.000	807.000	344.000
Caterpillar	G-398	420	r	HIS Corp	c	121.000	11.000	90.909	35721.000	190.000	5/11/1989	0.010	53.894	10132.400	449.000
Caterpillar	G-398	420	r	HoustonInd NSCR	c	874.000	21.000	97.600	3872.000	42.000	7/26/1990	0.100	12.000	1093.000	362.000
Caterpillar	G-398	420	r	Houston NSCR	c	0.000	33.000	0.000	8044.000	1.000	6/10/1992	0.100	1.000	2282.000	545.000
Caterpillar	G-398	420	r	HIS NSCR		81.200	0.400	0.000	34855.000	162.000	6/23/1987	0.100	0.000	0.000	404.000
Caterpillar	G-398	420	r	NSCR HIS		0.000	6.000	0.000	4915.000	53.000	8/2/1995	0.200	15.000	1401.000	449.000
Caterpillar	G-398	420	r	Houston NSCR	c	592.000	11.000	98.100	6435.000	29.000	9/6/1990	0.100	8.000	1817.000	382.000
Caterpillar	G-398	420	r	HIS NSCR		294.800	2.320	0.000	19890.000	128.300	6/23/1987	0.100	0.000	0.000	404.000
Caterpillar	G-398	420	r	NSCR		0.000	31.000	0.000	6274.000	131.000	6/29/1994	0.100	37.000	1771.000	503.000

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VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Caterpillar	G-398	420	r	NSCR	c	0.000	11.000	0.000	307.000	220.000	8/13/1996	0.100	62.000	87.000	702.000
Caterpillar	G-398	420	r	NSCR		0.000	12.000	0.000	14360.000	30.600	8/27/1997	0.001	8.600	4054.000	737.000
Waukesha	F2895	420	r	NSCR		241.000	30.000	0.000	12708.000	0.000	4/24/1991	0.100	0.000	3587.000	0.000
Waukesha	F2895	420	r	NSCR		0.000	1.000	0.000	9079.000	88.000	11/13/1991	0.100	25.000	2575.000	225.000
Waukesha	F2895	420	r	Houston NSCR	c	0.000	9.000	0.000	8319.000	25.000	6/24/1993	0.100	7.000	2360.000	485.000
Waukesha	F2839	420	r	NSCR HIS		0.000	7.000	0.000	6681.000	283.000	8/2/1995	0.200	81.000	1904.000	449.000
Waukesha	F2895	420	r	Houston NSCR	c	0.000	5.000	0.000	5094.000	1.000	6/10/1992	0.300	1.000	1459.000	533.000
Waukesha	F2895	420	r	NSCR Houston		0.000	19.000	0.000	654.000	79.000	6/29/1994	0.100	22.000	185.000	503.000
Waukesha	F2895G	420	r	NSCR	c	0.000	15.000	0.000	1487.000	13.000	7/25/1996	0.010	4.000	420.000	792.000
Waukesha	F2895G	420	r	NSCR		0.000	14.000	0.000	17446.000	18.300	8/27/1997	0.001	5.200	4925.000	821.000
Waukesha	F817GU	190	r	PSC		0.000	34.900	0.000	0.000	0.000	3/22/1994	6.500	9.800	214.300	174.000
Waukesha	F817GU	190	r	PSC Cat Conv	c	0.000	39.000	0.000	0.000	0.000	4/2/1993	7.300	36.900	268.000	249.000
Waukesha	F817GU	190	r	PSC-digester gs		0.000	12.500	0.000	0.000	0.000	6/9/1994	7.500	0.000	42.800	0.000
Waukesha	F817GU	190	r	PSC Cat Conv	c	0.000	30.000	0.000	514.000	35.000	12/1/1988	6.400	14.241	209.145	190.000
Waukesha	F817GU	190	r	PSC Cat Conv	c	0.000	27.000	0.000	428.000	132.000	12/10/1987	5.500	50.571	163.974	194.000
Waukesha	F817GU	190	r	PSC heat/cogen	c	0.000	39.000	0.000	583.000	40.000	12/13/1989	6.500	16.000	238.000	415.000
Waukesha	F817GU	190	r	PSC heat/cogen	c	0.000	25.410	0.000	452.840	10.000	1/9/1992	5.700	3.880	175.770	183.283
Waukesha	F817GU	190	r	PSC		0.000	48.000	0.000	547.000	143.000	2/28/1991	6.400	58.000	222.000	331.000
Waukesha	F817GU	190	r	PSC		0.000	21.600	0.000	0.000	0.000	3/28/1995	5.500	2.100	200.000	230.000
Waukesha	F817GU	190	r	PSC	c	0.000	42.300	0.000	611.800	18.400	3/27/1997	6.950	7.800	258.800	228.000
Waukesha	F817GU	190	r	PSC		0.000	34.900	0.000	0.000	0.000	2/23/1996	4.800	28.900	162.000	228.000
Waukesha	F817GU	190	r	PSC		0.000	40.000	0.000	453.000	173.000	2/28/1991	6.100	69.000	180.000	323.000
Waukesha	F817GU	190	r	PSC		0.000	47.900	0.000	0.000	0.000	3/22/1994	4.100	10.200	230.000	162.000
Waukesha	F817GU	190	r	PSC		0.000	43.800	0.000	0.000	0.000	3/28/1995	6.500	5.100	205.100	235.000
Waukesha	F817GU	190	r	PSC Cat Conv	c	0.000	41.000	0.000	484.000	24.000	12/1/1988	5.800	9.377	189.113	179.000
Waukesha	F817GU	190	r	PSC heat/cogen	c	0.000	45.000	0.000	606.000	38.000	12/13/1989	6.500	16.000	247.000	415.000
Waukesha	F817GU	190	r	PSC Cat Conv	c	0.000	16.000	0.000	0.000	0.000	4/2/1993	6.800	21.300	193.000	266.000
Waukesha	F817GU	190	r	PSC heat/cogen	c	0.000	36.980	0.000	567.080	12.500	1/9/1992	5.990	4.940	237.290	182.955
Waukesha	F817GU	190	r	PSC		0.000	35.400	0.000	0.000	0.000	2/23/1996	4.600	27.500	211.000	226.000
Waukesha	145GZU	100	r	PSC PreStrat Ch		0.000	24.000	0.000	18456.000	96.600	10/14/1988	15.100	98.266	18774.210	210.000
Waukesha	145GZU	100	r	PSC		53.000	56.000	0.000	56000.000	287.000	5/5/1988	0.010	81.058	15816.180	124.000
Minnepls-Moline	800-6A	160	r			0.000	591.000	0.000	641.000	139.000	5/18/1988	4.100	0.000	0.000	25.000
Minnepls-Moline	800-6A	160	r	NSCR HIS		738.000	54.000	92.700	4810.000	38.000	3/15/1990	0.100	11.000	1364.000	80.000
Minnepls-Moline	800-6A	160	r	NSCR		0.000	0.700	0.000	658.000	217.000	5/25/1995	0.100	62.000	187.000	71.000
Minnepls-Moline	800-6A	160	r	HIS	c	0.000	1.680	0.000	1388.100	126.600	5/21/1993	0.025	36.000	394.720	58.300
Minnepls-Moline	800-6A	160	r	NSCR		505.000	19.000	0.000	9004.000	55.000	5/6/1991	0.010	16.000	2542.000	100.000
Minnepls-Moline	800-6A	160	r	HIS, DN/S1475	c	0.000	7.000	0.000	3877.000	76.000	3/11/1992	0.100	21.000	1095.000	91.000

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Minnepls-Moline	800-6A	160	r	HIS, DN S1475	c	561.000	5.000	99.000	21125.000	225.000	12/5/1991	0.020	63.880	5969.230	89.000
Tecogen	CM-60	80	r	None	e	0.000	222.860	0.000	257.000	37.500	4/12/1989	4.800	0.000	15.115	149.000
Tecogen	CM-60	80	r	None	e	0.000	246.000	0.000	249.500	61.500	5/31/1989	4.200	0.000	16.602	135.700
Tecogen	CM-60	79	r	None	e	0.000	177.000	0.000	338.000	23.000	3/29/1989	3.200	2.029	29.818	146.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	39.000	0.000	3297.000	71.500	9/30/1991	0.302	0.000	945.000	0.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	11.000	0.000	6015.000	231.000	3/5/1993	0.400	67.000	1731.000	135.000
Waukesha	F1197GU	137	r	Cat	c	0.000	43.000	0.000	6101.000	68.000	2/15/1994	0.100	19.000	1731.000	98.000
Ajax	DCP-115	140	l	None	d	0.000	89.000	0.000	198.000	3400.000	5/17/1990	14.700	3235.000	188.000	422.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	10.000	0.000	1399.000	77.000	6/20/1995	0.100	22.000	397.000	111.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	33.000	0.000	7000.000	0.000	8/19/1991	0.040	0.000	1984.000	0.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	12.100	0.000	2545.800	54.700	7/31/1996	0.580	15.900	739.300	152.700
Waukesha	F1197GU	137	r	NSCR	c	0.000	3.000	0.000	1381.000	141.000	3/5/1993	0.100	40.000	392.000	230.000
Waukesha	F1197GU	137	r	Cat	c	0.000	25.000	0.000	3346.000	51.000	2/15/1994	0.300	14.000	958.000	99.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	39.200	0.000	5004.000	195.000	9/30/1991	0.026	0.000	1415.000	0.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	17.000	0.000	4000.000	0.000	8/19/1991	0.025	0.000	1131.000	0.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	18.000	0.000	2417.000	136.000	6/20/1995	0.100	39.000	686.000	111.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	11.500	0.000	3053.780	149.750	9/18/1990	0.010	42.280	862.070	180.000
Waukesha	F1197GU	137	r	NSCR	c	0.000	12.000	0.000	3435.500	26.300	7/31/1996	0.450	7.600	991.300	131.500
Tecogen	CM-60	86	r	NSCR Motorola		0.000	14.000	0.000	1430.000	43.000	12/2/1994	0.100	12.000	406.000	133.000
Tecogen	CM-75	108	r	NSCR		0.000	28.000	0.000	2378.000	0.000	7/16/1991	0.100	0.000	674.000	0.000
Tecogen	CM-60	86	r	NSCR Motorola		0.000	39.000	0.000	9733.000	423.000	12/2/1993	0.700	123.000	2843.000	119.000
Tecogen	CM-75	108	r	NSCR		0.000	1.000	0.000	8754.000	90.000	12/20/1991	0.300	26.000	2507.000	122.000
Tecogen	CM-75	108	r	NSCR		0.000	19.000	0.000	5977.000	710.000	12/16/1992	0.100	201.000	1696.000	115.000
Tecogen	CM-75	108	r	Englehard Cat	c	606.000	64.000	89.500	5095.000	21.000	3/30/1989	0.100	59.282	14383.014	156.000
Tecogen	CM-60	86	r	NSCR	c	0.000	16.000	0.000	6606.000	13.000	12/19/1997	2.300	4.100	2095.000	112.000
Tecogen	CM-60	89	r	NSCR	c	0.000	0.800	0.000	280.000	2.200	12/20/1996	0.010	0.060	79.000	102.000
Tecogen	CM-60	86	r	NSCR		0.000	11.000	0.000	2086.000	110.000	12/22/1995	0.100	31.000	592.000	113.000
Superior	8GTLB	1100	l	Clean Burn		0.000	85.000	0.000	470.000	0.000	3/18/1994	10.300	0.000	262.000	2607.200
Superior	8GTLB	1100	l	Clean Burn	c	0.000	31.000	0.000	476.000	0.000	3/18/1993	10.300	388.000	265.000	2651.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	13.000	0.000	567.000	5300.000	5/24/1990	11.500	3326.000	356.000	2971.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	9.500	0.000	660.000	0.000	9/6/1990	12.250	0.000	450.200	3014.500
Superior	8GTLB	1100	l	Clean Burn		0.000	124.000	0.000	538.000	362.000	3/29/1995	10.330	202.000	300.000	2397.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	11.000	0.000	650.000	0.000	3/12/1992	12.000	0.000	431.000	0.000
Superior	8GTLB	1100	l	Clean Burn		0.000	14.000	0.000	645.000	0.000	6/13/1991	11.800	425.000	418.000	3312.150
Superior	8GTLB	0	l	Pre-Comb Chmbr	c	0.000	66.000	0.000	518.000	263.000	3/17/1997	10.340	147.000	289.000	2328.000
Superior	8GTLB	0	l	Pre-Comb Chambr		0.000	75.000	0.000	568.000	141.000	3/26/1996	10.690	81.000	328.000	2486.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	26.000	0.000	639.000	0.000	3/18/1993	9.750	201.000	338.000	2432.000

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Superior	8GTLB	1100	l	Clean Burn		0.000	15.000	0.000	428.000	0.000	3/18/1994	11.250	0.000	262.000	2796.200
Superior	8GTLB	1100	l	Clean Burn	c	0.000	32.000	0.000	450.000	3380.000	5/24/1990	10.830	1979.000	264.000	2471.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	19.000	0.000	443.000	0.000	3/12/1992	11.380	0.000	274.000	0.000
Superior	8GTLB	1100	l	Clean Burn		0.000	36.000	0.000	438.000	0.000	6/13/1991	10.940	291.000	259.000	2683.150
Superior	8GTLB	1100	l	Clean Burn	c	0.000	15.800	0.000	480.000	0.000	9/5/1990	10.820	0.000	281.000	1965.700
Superior	8GTLB	1100	l	Clean Burn		0.000	23.000	0.000	409.000	417.000	3/28/1995	11.100	251.000	246.000	2499.000
Superior	8GTLB	0	l	Pre-Comb Chambr		0.000	68.000	0.000	580.000	142.000	3/26/1996	10.440	80.000	327.000	2362.000
Superior	8GTLB	0	l	Pre-Comb Chmbr	c	0.000	38.000	0.000	490.000	246.000	3/20/1997	10.220	136.000	271.000	2041.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	7.000	0.000	432.000	0.000	3/16/1993	11.030	270.000	258.000	2628.000
Superior	8GTLB	1100	l	Clean Burn		0.000	15.000	0.000	360.000	0.000	3/18/1994	11.000	0.000	215.000	2727.600
Superior	8GTLB	1100	l	Clean Burn	c	0.000	23.000	0.000	436.000	2650.000	5/23/1990	10.780	1544.000	254.000	2628.000
Superior	8GTLB	1100	l	Clean Burn		0.000	21.000	0.000	414.000	548.000	3/28/1995	11.250	335.000	253.000	2676.000
Superior	8GTLB	1100	l	Clean Burn	c	0.000	17.000	0.000	402.000	0.000	3/12/1992	11.200	0.000	245.000	0.000
Superior	8GTLB	1100	l	Clean Burn		0.000	18.000	0.000	465.000	0.000	6/14/1991	11.120	279.000	281.000	2894.480
Superior	8GTLB	1100	l	Clean Burn	c	0.000	14.100	0.000	510.000	0.000	9/6/1990	11.250	0.000	311.800	2796.300
Superior	8GTLB	0	l	Pre-Comb Chambr		0.000	46.000	0.000	463.000	135.000	3/26/1996	10.720	78.000	268.000	2362.000
Superior	8GTLB	0	l	Pre-Comb Chmbr	c	0.000	43.000	0.000	440.000	216.000	3/21/1997	10.570	123.000	251.000	2454.000
Tecogen	CM-200	291	l	Engelhard Cat	c	0.000	97.000	0.000	2880.000	110.000	3/17/1993	1.100	33.000	857.000	386.000
Cummins	GTA-855	291	l	Englehard Cat	c	354.000	10.000	97.200	26701.000	48.000	12/7/1989	0.100	16.000	7574.000	358.000
Tecogen	CM-200	291	l	Englehard Cat	c	646.000	36.000	94.500	1433.000	13.000	4/13/1990	0.100	4.000	405.000	370.000
Tecogen	CM-75	108	r	Dual Englehards	d	0.000	32.800	83.000	23000.000	125.000	8/24/1989	0.500	70.574	12985.646	141.000
Tecogen	CM-75	108	r	Dual Englehards	d	572.000	99.000	82.800	11000.000	27.000	3/30/1989	0.100	76.220	31052.632	141.000
Tecogen	CM-60	87	r	NSCR		0.000	14.000	0.000	8548.000	25.000	12/16/1992	0.100	7.000	2425.000	127.000
Tecogen	CM-60	87	r	NSCR		0.000	1.000	0.000	1966.000	10.000	2/8/1991	0.100	3.000	555.000	121.000
Tecogen	CM-60	87	r	NSCR		0.000	8.000	0.000	1745.000	0.000	7/16/1991	0.100	0.000	496.000	0.000
Tecogen	CM-60	87	r	NSCR Motorola		0.000	47.000	0.000	6217.000	16.000	12/2/1994	0.010	4.500	1755.000	128.000
Tecogen	CM-60	86	r	NSCR Motorola		0.000	26.000	0.000	5100.000	173.000	12/2/1993	0.100	49.000	1447.000	131.000
Tecogen	CM-60	87	r	NSCR		0.000	6.000	0.000	3933.000	14.000	11/8/1991	0.100	4.000	1116.000	123.000
Tecogen	CM-60	85	r	Dual Engelhards	c	0.000	10.000	0.000	0.000	0.000	9/18/1992	0.000	0.000	968.000	0.000
Tecogen	CM-60	86	r	NSCR		0.000	11.000	0.000	11245.000	128.000	12/22/1995	0.010	36.000	3174.000	117.000
Tecogen	CM-60	89	r	NSCR	c	0.000	20.000	0.000	2828.000	9.900	12/20/1996	0.010	2.800	798.000	121.000
Tecogen	C-60	86	r	NSCR	c	0.000	8.200	0.000	7941.000	5.400	12/19/1997	0.010	1.500	2242.000	108.000
Tecogen	CM-MarkV	87	r	EGR	e	0.000	382.000	0.000	630.000	130.000	12/16/1994	4.600	47.000	228.000	139.000
Tecogen	C-60	87	r	None	e	0.000	165.000	0.000	306.000	28.000	9/20/1989	3.660	9.650	105.000	138.700
Tecogen	C-60	87	r	None	e	0.000	192.000	0.000	264.000	35.000	9/20/1989	3.860	12.000	92.000	138.700
Tecogen	CM-MarkV	87	r	EGR	e	0.000	297.000	0.000	1305.000	98.000	12/16/1994	2.200	31.000	412.000	123.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	41.000	0.000	479.000	331.000	6/20/1991	9.700	175.000	252.000	1355.000

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F3521GL	616	l	Clean Burn		0.000	66.000	0.000	604.000	1028.000	7/17/1992	9.200	518.000	305.000	2520.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	38.000	0.000	380.000	111.000	8/20/1993	10.400	63.000	214.000	2370.000
Waukesha	F3521GL	616	l	Clean Burn	c	0.000	34.000	0.000	544.000	255.000	5/7/1990	9.800	135.000	294.000	976.000
Waukesha	L3521GL	616	l	Clean Burn		0.000	48.000	0.000	490.000	462.000	8/9/1995	9.900	248.000	263.000	1814.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	65.000	0.000	562.000	151.000	8/24/1994	9.800	80.000	296.000	1832.000
Waukesha	F3521GL	616			c	0.000	41.300	0.000	574.000	182.400	7/24/1997	11.150	110.400	347.400	1231.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	22.000	0.000	49.000	116.000	7/17/1992	10.500	66.000	28.000	2523.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	29.000	0.000	465.000	216.000	8/20/1993	11.500	136.000	292.000	2571.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	11.000	0.000	382.000	339.000	6/20/1991	10.300	189.000	213.000	2179.000
Waukesha	F3521GL	616	l	Clean Burn	c	0.000	35.000	0.000	530.000	224.000	5/7/1990	9.700	121.000	282.000	1006.000
Waukesha	F3521GL	616	l	Clean Burn		0.000	61.000	0.000	572.000	234.000	8/24/1994	9.400	120.000	293.000	1646.000
Waukesha	L3521GL	616	l	Clean Burn		0.000	62.000	0.000	583.000	683.000	8/9/1995	9.100	342.000	292.000	1582.000
Waukesha	F3521GL	616			c	0.000	28.200	0.000	558.900	157.200	7/24/1997	11.370	97.300	345.800	1413.000
Minneple-Moline	800-6A	80	r	NSCR		0.000	43.820	93.300	428.760	0.000	6/19/1991	0.040	10.520	121.270	58.700
Minnepls-Moline	800-6A	160	r	HIS NSCR		0.000	1.000	0.000	1030.000	101.800	6/14/1994	0.010	28.700	291.000	68.000
Minnepls-Moline	800-6A	160	r			0.000	538.000	0.000	771.000	208.000	5/18/1988	7.500	0.000	0.000	25.000
Tecogen	CM-75	109	r	NSCR		0.000	40.000	0.000	13041.000	8.300	1/24/1995	0.100	2.300	3681.000	122.000
Tecogen	CM-75	109	r	Engelhard Cat		0.000	22.000	0.000	4426.000	28.000	10/26/1993	0.100	8.000	1256.000	115.000
Tecogen	CM-75	108	r	Englehard Cat	c	0.000	39.000	0.000	1583.000	0.000	6/18/1992	1.500	0.000	481.000	8364.000
Tecogen	CM-75	109	r	NSCR-Engelhard	c	0.000	3.000	0.000	1922.000	88.000	8/15/1996	0.010	25.000	543.000	111.000
Tecogen	CM-60	87	r	NSCR		0.000	42.000	0.000	10175.000	27.000	1/24/1995	0.100	7.600	2876.000	141.000
Tecogen	CM-60	87	r	Engelhard Cat		0.000	8.000	0.000	1240.000	116.000	10/26/1993	0.200	33.000	352.000	105.000
Tecogen	CM-60	87	r	Englehard Cat	c	0.000	9.000	0.000	551.000	0.000	6/18/1992	1.100	0.000	164.000	7484.000
Tecogen	CM-60	87	r	Englehard Cat	c	7452.000	10.000	98.700	5143.000	6.000	6/18/1990	0.100	2.000	1452.000	117.000
Tecogen	CM-60	89	r	NSCR-Engelhard	c	0.000	5.000	0.000	4688.000	146.000	8/15/1996	0.010	41.000	1323.000	108.000
Waukesha	VGR 330	26	r	None	m	0.000	21.000	0.000	52250.000	6800.000	1/17/1991	5.660	0.000	0.000	35.000
Waukesha	VGR 330	26	r	None	m	0.000	551.000	0.000	4585.000	289.000	1/17/1991	1.510	0.000	0.000	74.000
Waukesha	VGR 330	26	r	None	m	0.000	742.000	0.000	330.000	243.000	1/17/1991	6.040	0.000	0.000	58.000
Waukesha	VGR 330	26	r	None	m	0.000	1071.000	0.000	910.000	614.000	1/17/1991	1.660	0.000	0.000	28.000
Tecogen	CM-60	87	r	Engelhard Cat		0.000	6.000	0.000	638.000	21.000	10/26/1993	0.200	6.000	181.000	102.000
Tecogen	CM-60	87	r	Englehard Cat	c	732.000	1.000	99.800	2653.000	11.000	6/18/1990	0.100	3.000	777.000	115.000
Tecogen	CM-60	87	r	Englehard Cat	c	0.000	1.000	0.000	1271.000	0.000	6/18/1992	1.000	0.000	377.000	6361.000
Tecogen	CM-60	87	r	NSCR		0.000	34.000	0.000	8880.000	13.000	1/24/1995	0.100	3.700	2510.000	141.000
Tecogen	CM-60	89	r	NSCR-Engelhard	c	0.000	9.000	0.000	538.000	222.000	8/15/1996	0.010	63.000	152.000	101.000
Waukesha	F1197GU	186	r	NSCR	c	725.000	36.000	95.000	1150.000	0.000	3/15/1993	0.030	59.000	495.000	280.000
Waukesha	F1197GU	186	r	NSCR		728.000	26.000	96.000	2873.000	0.000	3/17/1994	0.030	0.000	812.000	292.500
Waukesha	F1197GU	186	r	NSCR		611.000	7.000	99.000	4750.000	0.000	6/12/1991	0.020	27.000	1342.000	284.870

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Waukesha	F1197GU	186	r	NSCR		0.000	43.000	0.000	2831.000	310.000	3/27/1995	0.030	88.000	800.000	254.000
Waukesha	F1197GU	186	r	NSCR	c	992.000	53.000	94.670	1346.000	265.000	5/23/1990	0.030	74.900	380.500	289.200
Waukesha	F1197GU	186	r	NSCR	c	749.000	47.000	93.740	2400.000	400.000	9/20/1989	0.030	113.000	678.000	288.200
Waukesha	F1197GU	186	r	NSCR		626.000	28.000	96.000	3728.000	402.000	6/11/1991	0.030	114.000	1057.000	284.680
Waukesha	F1197GU	186	r	NSCR	c	575.000	23.000	96.000	4330.000	0.000	3/10/1992	0.160	0.000	1232.000	0.000
Waukesha	F1197FU	0	r	NSCR	c	0.000	45.000	0.000	1555.000	51.000	3/18/1997	0.020	14.000	439.000	240.000
Waukesha	F1197FU	0	r	NSCR		0.000	33.000	0.000	2156.000	70.000	3/27/1996	0.030	20.000	610.000	231.000
Waukesha	L5790GU	748	r	ESC		0.000	3.000	0.000	2066.000	110.000	8/2/1994	0.100	26.000	583.000	640.000
Waukesha	L5790GU	748	r	ESC		882.110	63.970	92.580	622.960	24.310	10/20/1988	0.030	6.870	176.110	811.290
Waukesha	L5790GU	748	r	NSCR		754.000	69.000	0.000	2438.000	47.000	8/7/1991	0.100	13.000	688.000	706.000
Waukesha	L5790GU	748	r	ESC	c	391.000	49.000	87.430	14558.000	54.000	10/6/1989	0.030	32.700	4115.200	0.000
Waukesha	L5790GU	748	r	ESC	c	322.000	28.000	91.080	7917.000	84.000	8/9/1990	0.010	51.800	2236.000	728.000
Waukesha	L5790GU	748	r	ECS NSCR	c	571.000	46.000	92.000	9963.000	70.000	7/27/1992	0.040	19.860	2818.000	728.000
Waukesha	L5790GU	748	r	ESC		0.000	2.000	0.000	4326.000	1830.000	10/5/1993	0.100	517.000	1221.000	747.000
Waukesha	L5790GU	748	r	ESC Model 45		0.000	36.000	0.000	5770.000	50.000	10/6/1993	0.100	14.000	1629.000	672.000
Waukesha	L5790GU	748	r	ESC Model 45	c	588.000	31.000	94.660	8648.000	8.800	10/2/1989	0.010	4.180	2442.700	0.000
Waukesha	L5790GU	748	r	ESC Model 45	c	622.000	52.000	92.540	14201.000	86.000	8/9/1990	0.020	53.300	4013.000	749.000
Waukesha	L5790GU	748	r	ESC NSCR	c	835.650	48.560	0.000	1000.000	33.650	12/20/1988	0.080	9.540	283.380	729.800
Waukesha	L5790GU	748	r	NSCR		671.000	45.000	0.000	8062.000	57.000	8/7/1991	0.300	16.000	2309.000	772.000
Waukesha	L5790GU	748	r	ESC		0.000	6.000	0.000	383.000	30.000	8/25/1994	0.200	8.400	109.000	676.000
Waukesha	L5790GU	748	r	ECS NSCR	c	782.000	65.000	91.700	10017.000	43.000	7/27/1992	0.060	12.000	2836.000	766.000
Waukesha	L5790GU	748	r	NSCR		0.000	0.790	0.000	6705.500	77.500	7/11/1995	0.030	18.800	1896.100	643.600
Waukesha	H-2000	227	r		m	0.000	542.850	0.000	143.000	4773.000	2/1/1991	18.020	0.000	241.900	1014.000
Waukesha	F1197GU	200	r	None	m	0.000	882.000	0.000	399.000	128.000	1/16/1991	2.120	0.000	0.000	229.000
Waukesha	F1197GU	200	r	None	m	0.000	535.000	0.000	15850.000	197.000	1/16/1991	0.280	0.000	0.000	228.000
Waukesha	F1197GU	200	r	None	m	0.000	958.000	0.000	515.000	120.000	1/16/1991	2.850	0.000	0.000	250.000
Waukesha	F1197GU	200	r	None	m	0.000	613.000	0.000	11450.000	205.000	1/16/1991	0.680	0.000	0.000	251.000
Waukesha	F1197GU	200	r	None	m	0.000	155.000	0.000	52450.000	276.000	1/16/1991	0.570	0.000	0.000	227.000
Waukesha	F1197GU	200	r	None	m	0.000	758.000	0.000	3415.000	370.000	1/16/1991	0.320	0.000	0.000	235.000
Waukesha	F1197GU	200	r	None	m	0.000	1166.000	0.000	345.000	108.000	1/16/1991	1.250	0.000	0.000	217.000
Waukesha	F1197GU	200	r	None	m	0.000	575.000	0.000	13250.000	162.000	1/16/1991	0.590	0.000	0.000	244.000
Waukesha	F1197GU	200	r	None	m	0.000	860.000	0.000	464.000	201.000	1/16/1991	0.700	0.000	0.000	219.000
Waukesha	F1197GU	200	r	None	m	0.000	896.000	0.000	591.000	265.000	1/16/1991	0.910	0.000	0.000	241.000
Waukesha	F1197GU	200	r	None	m	0.000	270.000	0.000	15000.000	273.000	1/16/1991	0.130	0.000	0.000	272.000
		68		None	m	0.000	81.000	0.000	637.000	5667.000	1/29/1991	9.740	0.000	336.000	32.300
		68		None	m	0.000	5.250	0.000	587.000	420.000	1/29/1991	6.220	0.000	236.000	54.490
		68		None	m	0.000	201.000	0.000	1361.000	1729.000	1/28/1991	4.250	0.000	483.000	20.540

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
		68		None	m	0.000	238.000	0.000	1615.000	1215.000	1/25/1991	3.900	0.000	0.000	16.000
		68		None	m	0.000	143.000	0.000	779.000	2814.000	1/28/1991	7.140	0.000	334.000	36.060
		68		None	m	0.000	6.400	0.000	643.000	632.000	1/28/1991	6.730	0.000	268.000	44.890
		68		None	m	0.000	21.500	0.000	1201.000	1109.000	1/24/1991	6.150	0.000	480.000	39.410
		68		None	m	0.000	109.000	0.000	1270.000	1153.000	1/23/1991	4.630	0.000	461.000	26.500
		68		None	m	0.000	22.800	0.000	0.000	2251.000	1/23/1991	7.140	0.000	0.000	28.600
		68		None	m	0.000	208.000	0.000	1004.000	1216.000	1/30/1991	5.130	0.000	376.000	30.880
		68		None	m	0.000	13.800	0.000	880.000	1087.000	1/30/1991	6.330	0.000	357.000	29.680
		68		None	m	0.000	98.800	0.000	972.000	964.000	1/23/1991	5.440	0.000	371.000	27.120
		68		None	m	0.000	8.110	0.000	1096.000	1210.000	1/31/1991	7.060	0.000	467.000	28.720
		68		None	m	0.000	3.830	0.000	994.000	1672.000	1/24/1991	6.960	0.000	421.000	25.060
		68		None	m	0.000	5.870	0.000	738.000	509.000	1/29/1991	5.600	0.000	285.000	31.530
Waukesha	VRG 310U	68	r	None	m	0.000	5.210	0.000	630.000	3303.000	1/30/1991	6.450	0.000	259.000	39.000
Waukesha	VRG 310U	68	r	None	m	0.000	232.000	0.000	3574.000	908.000	1/31/1991	1.790	0.000	1103.000	24.290
Waukesha	VRG 310U	68	r	None	m	0.000	55.100	0.000	237.000	1866.000	1/24/1991	14.070	0.000	204.000	63.080
		68		None	m	0.000	98.000	0.000	1025.000	1720.000	1/23/1991	4.200	0.000	0.000	28.000
		68		None	m	0.000	81.000	0.000	568.000	857.000	1/21/1991	7.100	0.000	0.000	55.000
		68		None	m	0.000	62.000	0.000	587.000	5355.000	1/22/1991	10.400	0.000	0.000	39.000
		74		None	m	0.000	111.000	0.000	33450.000	3150.000	1/23/1991	1.500	0.000	0.000	20.000
		74		None	m	0.000	49.000	0.000	43400.000	8170.000	1/22/1991	4.000	0.000	0.000	30.000
		74		None	m	0.000	19.000	0.000	147.000	4050.000	1/22/1991	11.400	0.000	0.000	70.000
		53		None	m	0.000	2.000	0.000	397.000	1235.000	1/25/1991	11.600	0.000	0.000	72.000
		48		None	m	0.000	24.000	0.000	679.000	909.000	1/21/1991	5.500	0.000	0.000	27.000
Waskesha	VGR232U	42	r	None	m	0.000	390.000	0.000	3770.000	1999.000	1/31/1991	1.530	0.000	1148.000	20.810
		42		None	m	0.000	63.000	0.000	1395.000	1635.000	1/22/1991	4.500	0.000	0.000	18.000
		42		None	m	0.000	431.000	0.000	1420.000	7455.000	1/24/1991	8.200	0.000	0.000	24.000
		26		None	m	0.000	41.600	0.000	2587.000	1528.000	1/28/1991	4.050	0.000	906.000	13.110
		26		None	m	0.000	731.000	0.000	1210.000	1935.000	1/24/1991	13.100	0.000	0.000	43.000
		26		None	m	0.000	286.000	0.000	1140.000	1277.000	1/28/1991	2.810	0.000	374.000	20.050
		26		None	m	0.000	27.000	0.000	854.000	1235.000	1/24/1991	8.300	0.000	0.000	18.000
Waukesha	FCU	19	r	None	m	0.000	55.500	0.000	0.000	21.000	1/30/1991	2.180	0.000	0.000	20.920
Milleapolis-Mol	336A-4A	60	r	None	m	0.000	401.000	0.000	729.000	7863.000	1/29/1991	7.640	0.000	324.000	31.470
		60		None	m	0.000	22.000	0.000	660.000	256.000	1/24/1991	2.800	0.000	0.000	23.000
		60		None	m	0.000	215.000	0.000	1422.000	1789.000	1/23/1991	6.630	0.000	588.000	23.250
		60		None	m	0.000	170.000	0.000	950.000	757.000	1/24/1991	8.620	0.000	456.000	30.720
		53		None	m	0.000	1071.000	0.000	824.000	889.000	1/21/1991	4.000	0.000	0.000	44.000
Minneapolis-Mol	283-4A	28	r	None	m	0.000	5.180	0.000	1018.000	1115.000	1/31/1991	7.930	0.000	463.000	21.640

Table D-2

VENTURA COUNTY APCD SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	RICH/ LEAN	CONTROLS	ST	NOX IN	NOX OUT	NOX REDUCED	CO OUT	NMHC PPM	DATE TEST	O2%	NMHC 15%O2	CO 15%O2	QST
Caterpillar	G-342C	225	r	NSCR - HIS		128.000	19.000	0.000	7614.000	72.000	2/23/1994	0.100	20.000	2149.000	263.000
Caterpillar	G-342C	225	r	NSCR Houston		0.000	12.000	0.000	5164.000	41.000	2/23/1995	0.010	12.000	1458.000	227.000
Caterpillar	G-342C	225	r	Houston NSCR	c	0.000	9.000	0.000	2515.000	16.000	12/22/1992	0.100	4.000	713.000	183.000
Caterpillar	G-342C	225	r	NSCR		0.000	15.000	0.000	7822.000	55.000	9/9/1991	0.100	16.000	2213.000	203.000
Caterpillar	G-342C	225	r	NSCR	c	0.000	15.000	0.000	10951.000	9.000	6/19/1997	0.100	3.000	3091.000	209.000
Caterpillar	G-342C	225	r	NSCR		0.000	14.000	0.000	12225.000	268.000	3/11/1996	0.100	76.000	3451.000	214.000
Superior	16SGTA	2650	l	Clean Burn		0.000	51.200	0.000	0.000	0.000	11/17/1993	8.300	0.000	190.000	6127.000
Superior	16SGTA	2650	l	Landfill Gas		0.000	44.000	0.000	431.000	32.000	7/21/1993	8.100	15.000	199.000	7315.000
Superior	16SGTA	2550	l	Landfill Gas		0.000	53.560	0.000	324.470	13.630	2/3/1992	8.040	6.250	148.860	6332.900
Superior	16SGTA	2650	l	Lndfl Gas		0.000	32.000	0.000	302.000	125.000	6/1/1994	7.400	0.000	139.000	5078.000
Superior	16SGTA	2650	l	Clean Burn		0.000	36.000	0.000	338.000	26.600	8/9/1994	7.600	11.800	150.000	5592.000
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	50.300	0.000	365.500	89.700	7/23/1996	7.740	40.400	163.800	6011.300
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	33.300	0.000	385.500	49.200	7/15/1997	7.710	22.000	174.000	5794.000
Superior	16SGTA	2650	1	Landfill Gas	c	0.000	46.300	0.000	280.800	64.400	3/12/1996	7.870	29.200	127.200	5875.000

TABLE D-3

SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	F2895GU	275	0	PSC	D. Gas	12/3/1993	22.20	259.00	12.00
Waukesha	F2895GU	275	0	PSC	D. Gas	12/2/1993	32.00	135.00	1.30
Waukesha	F2895GU	275	0	PSC	D. Gas	12/2/1993	23.80	182.00	144.00
Waukesha	F2895GU	275	0	PSC	D. Gas	7/20/1995	23.51	183.56	0.89
Waukesha	F2895GU	275	0	PSC	D. Gas	7/19/1995	34.67	157.00	29.60
Waukesha	F2895GU	275	0	PSC	D. Gas	7/19/1995	22.35	169.00	32.00
Mpls Moline	HEB	46	0	None	Field Gas	11/12/1991	467.00		
Waukesha	140	49.5	0	None	Field Gas	11/4/1991	723.00		
Waukesha	140	49.5	0	PSC	Field Gas	11/4/1991	195.70		
Waukesha	WAK	49.6	0	None	Field Gas	11/4/1991	1412.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/4/1991	632.00		
Waukesha	WAK	49.6	0	None	Field Gas	11/5/1991	420.70		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/5/1991	134.30		
Waukesha	WAK	49.6	0	None	Field Gas	11/6/1991	415.70		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/6/1991	306.70		
Waukesha	WAK	49.6	0	None	Field Gas	11/6/1991	585.70		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/6/1991	137.00		
Waukesha	WAK	49.6	0	None	Field Gas	11/7/1991	66.20		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/7/1991	8.90		
Waukesha	145	49.6	0	None	Field Gas	11/13/1991	841.00		
Waukesha	145	49.6	0	PSC	Field Gas	11/13/1991	6.00		
Waukesha	145	49.6	0	None	Field Gas	11/14/1991	71.30		
Waukesha	145	49.6	0	PSC	Field Gas	11/14/1991	49.80		
Waukesha	145	49.6	0	None	Field Gas	11/13/1991	648.00		
Waukesha	145	49.6	0	PSC	Field Gas	11/13/1991	7.40		
Waukesha	145	49.6	0	None	Field Gas	11/12/1991	380.70		
Waukesha	145	49.6	0	PSC	Field Gas	11/12/1991	29.30		
Waukesha	145	49.6	0	None	Field Gas	11/11/1991	194.70		
Waukesha	145	49.6	0	PSC	Field Gas	11/11/1991	3.90		
Waukesha	145	49.6	0	None	Field Gas	11/11/1991	85.50		
Waukesha	145	49.6	0	PSC	Field Gas	11/11/1991	7.60		
Waukesha	145	49.6	0	None	Field Gas	11/15/1991	285.70		
Waukesha	145	49.6	0	PSC	Field Gas	11/15/1991	8.80		
Mpls Moline	165	25	0	Lean-out adj	Field Gas	11/4/1991	840.70		
Mpls Moline	165	25	0	None	Field Gas	11/4/1991	81.90		
Mpls Moline	165	25	0	None	Field Gas	11/6/1991	53.50		
Mpls Moline	165	25	0	None	Field Gas	11/4/1991	70.50		
Waukesha	145	49.5	0	None	Field Gas	11/8/1991	889.00		
Waukesha	145	49.5	0	PSC	Field Gas	11/8/1991	413.30		
Waukesha	WAK	49.6	0	None	Field Gas	11/8/1991	763.70		
Waukesha	WAK	49.6	0	PSC	Field Gas	11/8/1991	290.30		
Waukesha	140	49.5	0	None	Field Gas	11/14/1991	631.70		
Waukesha	140	49.5	0	PSC	Field Gas	11/14/1991	384.80		
Waukesha	WAK	49.5	0	None	Field Gas	11/15/1991	79.50		
Waukesha	WAK	49.5	0	PSC	Field Gas	11/15/1991	11.60		
Mpls Moline	605	46	0	None	Field Gas	11/7/1991	191.70		
Mpls Moline	605	46	0	PSC	Field Gas	11/7/1991	48.90		

TABLE D-3

SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Mpls Moline	605	46	0	PSC	Field Gas	10/26/1993	128.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1993	174.00		
Waukesha	140	49.5	0	PSC	Field Gas	10/21/1993	19.90		
Waukesha	145	49.5	0	PSC	Field Gas	10/25/1993	206.00		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1993	5.78		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1993	18.30		
Waukesha	145	49.5	0	PSC	Field Gas	10/28/1993	37.00		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1993	38.40		
Waukesha	140	49.5	0	PSC	Field Gas	10/26/1993	252.00		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1993	35.10		
Waukesha	145	49.6	0	PSC	Field Gas	10/28/1993	4.39		
Waukesha	145	49.6	0	PSC	Field Gas	10/28/1993	6.87		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1993	910.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/22/1993	93.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/22/1993	154.00		
Waukesha	WAK	49.5	0	PSC	Field Gas	10/21/1993	26.20		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1993	70.10		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/26/1993	203.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1994	85.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1994	85.00		
Waukesha	140	49.5	0	PSC	Field Gas	10/24/1994	19.40		
Waukesha	140	49.5	0	PSC	Field Gas	10/25/1994	201.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/26/1994	89.70		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/26/1994	57.70		
Waukesha	WAK	49.5	0	PSC	Field Gas	10/25/1994	24.30		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/26/1994	135.00		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/25/1994	232.00		
Waukesha	145	49.5	0	PSC	Field Gas	10/24/1994	59.40		
Waukesha	WAK	49.6	0	PSC	Field Gas	10/24/1994	417.00		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	8.06		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	81.70		
Waukesha	145	49.5	0	PSC	Field Gas	10/27/1994	57.00		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	7.96		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	31.80		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	8.15		
Waukesha	145	49.6	0	PSC	Field Gas	10/27/1994	8.81		
Clark	RA-4	400	1	None	Field Gas	11/2/1992	164.87	100.93	
Clark	RA-4	400	1	None	Field Gas	11/3/1992	799.27	481.20	
Mpls Moline	HEB	46	0	None	Field Gas	11/4/1992	14775.00		
Mpls Moline	HEB	46	0	None	Field Gas	10/20/1993	86.60		
Waukesha	140	82	0	None	Field Gas	10/20/1993	269.00		15.00
Waukesha	195	63	0	None	Field Gas	10/13/1993	312.00	144.00	19.00
Mpls Moline	HEB	46	0	None	Field Gas	10/19/1994	412.00		
Caterpillar	G342	225	0	Lean-out adj	Field Gas	10/20/1992	28.70	149.00	70.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/20/1992	11.70	277.00	78.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/20/1992	15.80	255.00	70.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/21/1992	20.60	165.00	61.00

TABLE D-3

SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	145	131	0	Lean-out adj	Field Gas	10/5/1994	35.30	255.00	71.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/5/1994	23.10	254.00	166.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/5/1994	15.40	327.00	552.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/20/1992	16.20	217.00	42.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/5/1994	31.60	209.00	29.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/14/1992	20.40	324.00	125.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/13/1992	9.10	197.00	182.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/14/1992	18.60	225.00	85.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/13/1992	15.10	372.00	509.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/13/1992	10.60	150.00	35.00
Waukesha	195	63	0	Lean-out adj	Field Gas	11/6/1992	4.05	302.00	122.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/15/1992	23.70	137.00	38.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/14/1992	19.00	170.00	55.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/13/1992	8.70	211.00	65.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/15/1992	17.30	126.00	53.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/20/1993	26.30	227.00	88.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/20/1993	70.00	170.00	70.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/20/1993	23.10	181.00	47.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/20/1993	171.70		
Waukesha	195	63	0	Lean-out adj	Field Gas	10/20/1993	21.70	135.00	44.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/20/1993	31.40	109.00	22.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/20/1993	28.50	207.00	60.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/20/1993	13.80	117.00	18.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/20/1993	33.70	185.00	38.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/20/1993	12.10	159.00	49.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/18/1994	21.00	267.00	174.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/18/1994	25.00	168.00	77.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/19/1994	21.80	207.00	91.00
Mpls Moline	165	25	0	Lean-out adj	Field Gas	10/18/1994	25.00		
Waukesha	195	63	0	Lean-out adj	Field Gas	10/19/1994	15.60	108.00	46.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/19/1994	33.00	189.00	53.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/18/1994	16.50	318.00	306.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/19/1994	30.50	114.00	19.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/19/1994	32.50	189.00	53.00
Waukesha	195	63	0	Lean-out adj	Field Gas	10/21/1994	23.00	110.00	39.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/15/1992	18.00	194.00	90.00
Mpls Moline	425	39	0	Lean-out adj	Field Gas	10/16/1992	15.50	305.00	96.00
Mpls Moline	425	39	0	Lean-out adj	Field Gas	10/19/1992	10.40	211.00	89.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/19/1992	12.20	202.00	52.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/16/1992	12.70	154.00	31.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/19/1992	14.50	239.00	51.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/16/1992	16.50	211.00	72.00
Waukesha	145	49	0	Lean-out adj	Field Gas	10/15/1992	19.70	369.00	109.00
Waukesha	145	49	0	Lean-out adj	Field Gas	10/16/1992	22.00	248.00	59.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/13/1993	14.50	185.00	64.00
Mpls Moline	425	39	0	Lean-out adj	Field Gas	10/14/1993	33.00	406.00	155.00
Mpls Moline	425	39	0	Lean-out adj	Field Gas	10/15/1993	21.20	197.00	47.00

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SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/15/1993	17.30	212.00	155.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/14/1993	12.20	230.00	31.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/15/1993	23.30	224.00	37.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	10/14/1993	25.80	261.00	44.00
Waukesha	145	49	0	Lean-out adj	Field Gas	10/13/1993	26.80	326.00	74.00
Waukesha	145	49	0	Lean-out adj	Field Gas	10/14/1993	13.80	381.00	101.00
Mpls Moline	605	46	0	Lean-out adj	Field Gas	11/3/1994	7.10	302.00	120.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	1/8/1993	80.30	375.00	1265.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	1/8/1993	97.30	360.00	2080.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/13/1995	43.49	210.00	306.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/13/1995	33.20	199.00	296.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/28/1993	78.70	206.00	229.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/28/1993	24.60	2.42	644.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/13/1995	56.90	341.00	309.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/13/1995	29.50	218.00	269.00
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/20/1993	7.90	288.00	196.46
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/19/1993	16.00	302.00	61.31
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/19/1993	13.70	252.00	80.47
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/16/1993	29.00	248.00	69.66
Mpls Moline	HEB	46	0	Lean-out adj	Field Gas	7/20/1993	73.00	314.00	108.24
Mpls Moline	HEB	46	0	Lean-out adj	Field Gas	7/19/1993	11.20	229.00	85.69
Mpls Moline	HEB	46	0	Lean-out adj	Field Gas	7/20/1993	22.70	224.00	66.36
Mpls Moline	HEB	46	0	Lean-out adj	Field Gas	7/19/1993	17.90	207.00	40.78
Waukesha	190	46	0	Lean-out adj	Field Gas	7/16/1993	25.60	175.00	37.49
Waukesha	2475	301	0	None	Field Gas	7/12/1993	25.70	126.00	50.05
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/15/1993	12.30	213.00	80.04
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/13/1993	7.70	250.00	25.19
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/13/1993	13.70	184.00	74.39
Mpls Moline	425	39	0	Lean-out adj	Field Gas	3/13/1993	14.70	148.00	64.32
Mpls Moline	425	39	0	Lean-out adj	Field Gas	7/14/1993	17.20	291.00	71.95
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/16/1993	16.60	251.00	55.47
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/15/1993	14.60	177.00	46.64
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/15/1993	23.50	129.00	25.95
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/13/1993	25.10	250.00	98.37
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/15/1993	17.00	190.00	70.09
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/14/1993	20.00	158.00	35.44
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/16/1993	18.60	279.00	51.50
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/16/1993	20.00	195.00	66.76
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/14/1993	27.50	172.00	34.16
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/12/1993	20.00	184.00	52.72
Mpls Moline	605	46	0	Lean-out adj	Field Gas	7/14/1993	24.00	202.00	47.94
Waukesha	F1197	195	0	NSCR	Field Gas	7/21/1993	3.60	524.00	3.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/25/1993	0.50	1157.00	54.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/28/1993	0.80	2870.00	29.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/22/1993	2.60	209.00	5.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/23/1993	0.60	2228.00	22.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/24/1993	2.40	4032.00	30.00

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SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	F1197	195	0	NSCR	Field Gas	7/22/1993	13.40	763.00	18.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/23/1993	0.70	1308.00	41.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/21/1993	11.50	988.00	7.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1993	0.60	5930.00	82.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/22/1993	5.10	1354.00	18.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/20/1993	6.30	535.00	20.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1993	0.20	2570.00	42.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1993	1.00	3788.00	70.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/23/1993	19.70	5538.00	51.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/28/1993	0.60	367.00	1.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/25/1993	7.00	1060.00	51.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/26/1993	3.30	2569.00	19.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/24/1993	5.10	2005.00	43.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/26/1993	0.70	1397.00	24.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/25/1993	0.30	847.00	88.00
Waukesha	F1197	195	0	NSCR	Field Gas	7/26/1995	1.80	647.10	20.50
Waukesha	F1197	195	0	NSCR	Field Gas	7/26/1995	4.10	2445.00	34.90
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1995	11.20	1212.00	15.10
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1995	14.00	1283.00	8.10
Waukesha	F1197	195	0	NSCR	Field Gas	7/26/1995	8.00	79.30	1.80
Waukesha	F1197	195	0	NSCR	Field Gas	7/27/1995	7.96	1636.00	19.20
Clark	RA-4	400	1	Intake air water inj. sys & ign. timing retard	Field Gas	4/13/1994	81.10	100.00	154.00
Clark	RA-4	400	1	Lean-out adj	Field Gas	7/13/1994	44.50	98.60	278.00
Buda	6MO	174	0	NSCR	Field Gas	3/29/1994	12.60	272.00	25.00
Buda	8MO	174	0	NSCR	Field Gas	3/29/1994	2.60	134.00	9.00
Buda	6MO	174	0	NSCR	Field Gas	3/29/1994	1.00	98.00	0.20
Buda	6MO-672	135	0	NSCR	Field Gas	3/29/1994	8.60	160.00	15.00
Lufkin	L1770	125	0	NSCR	Field Gas	3/29/1994	18.80	32.96	390.58
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	3/22/1996	172.00	753.00	881.00
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	2/11/1994	108.00	274.00	392.00
Clark	RA-4	400	1	Fuel charge shrouding inj. sys.	Field Gas	3/28/1994	52.00	425.00	550.00
Clark	RA-4	400	1	Fuel charge shrouding inj. sys.	Field Gas	3/28/1994	100.00	111.00	137.00
Waukesha	145	131	0	Lean-out adj	Field Gas	11/21/1994	19.90	299.00	174.00
Waukesha	145	131	0	Lean-out adj	Field Gas	1/6/1995	23.40	159.00	35.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/17/1995	20.50	333.00	998.00
Waukesha	145	131	0	Lean-out adj	Field Gas	10/21/1992	20.50	333.00	998.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/17/1997	112.00	358.00	336.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/18/1997	86.00	286.00	438.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/17/1997	44.00	233.00	405.00
Waukesha	F1197	195	0	NSCR	Field Gas	8/14/1997	11.00	941.00	9.00
Waukesha	F1197	195	0	NSCR	Field Gas	8/14/1997	3.00	1063.00	14.00

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SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	F1197	195	0	NSCR	Field Gas	8/14/1997	10.00	94.00	3.00
Waukesha	F1197	195	0	NSCR	Field Gas	8/15/1997	2.00	462.00	0.00
Waukesha	F1197	195	0	NSCR	Field Gas	8/15/1997	2.00	268.00	2.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/18/1997	94.00	252.00	313.00
Buda	6MO	174	0	NSCR	Field Gas	8/15/1997	0.00	471.00	13.00
Clark	RA-4	400	1	Intake air water inj. sys & ign. timing retard	Field Gas	1/9/1996	73.40	451.00	257.00
Buda	6MO	174	0	NSCR	Field Gas	3/26/1996	18.10	287.00	2.50
Buda	6MO-672	135	0	NSCR	Field Gas	3/26/1996	0.30	196.00	1.80
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	4/15/1996	123.00	565.00	719.00
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	4/15/1996	123.00	565.00	719.00
Waukesha	6LRZ	410	0	NSCR	Field Gas	4/7/1997	10.10	12.00	0.00
Waukesha	F-1197G WAK	190	0	NSCR	Field Gas	5/30/1997	0.90	4.10	1.90
Caterpillar	G342	225	0	Lean-out adj	Field Gas	4/7/1997	0.60	9.70	0.00
Waukesha	2475	301	0	Lean Adj. Tune	Field Gas	11/24/1997	42.10	154.20	10.40
Caterpillar	G398-TAHC	713	0	NSCR	Field Gas	12/15/1997	3.60	165.00	0.14
Waukesha	F-1197	186	0	NSCR	Field Gas	3/27/1997	8.76	107.70	11.02
Waukesha	F-1197	186	0	NSCR	Field Gas	3/27/1997	1.11	30.05	10.08
Caterpillar	G398-TAHC	713	0	NSCR	Field Gas	9/9/1999	65.00		
Waukesha	F-1197G WAK	190	0	NSCR	Field Gas	5/4/1999	29.00	1.00	5.00
Clark	RA-4	400	1	Intake air water inj. sys. & ign. timing retard	Field Gas	4/28/1998	94.00	474.00	415.00
Waukesha	F-1197G WAK	190	0	NSCR	Field Gas	5/8/1998	4.00	17.00	0.70
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	5/26/1998	161.00	691.00	
Clark	HRA-8	880	1	Fuel charge shrouding inj. sys.	Field Gas	6/10/1998	125.00	617.00	333.00
Waukesha	F3521Gsi	747	0	NSCR	Field Gas	1/14/1999	10.00	41.00	
Buda	6MO	174	0	NSCR	Field Gas	4/27/1999	5.00	510.00	6.00
Waukesha	F1197	195	0	NSCR	Field Gas	4/27/1999	6.00	667.00	1.00
Clark	HRA-6T	792	1	LB Adj.	Field Gas	4/28/1999	99.00	351.00	376.00
Waukesha	F1197	195	0	NSCR	Field Gas	4/28/1999	78.00	350.00	462.00
Waukesha	F1197	195	0	NSCR	Field Gas	4/27/1999	11.00	368.00	7.00
Caterpillar	G-342 NAHCR	225	0	NSCR	Field Gas	6/11/1999	0.86	58.00	11.00
Waukesha	F-1197G WAK	190	0	NSCR	Field Gas	7/16/1999	9.00	40.00	2.00
Waukesha	F-1197G WAK	190	0	NSCR	Field Gas	5/4/1999	29.00	1.00	5.00
Waukesha	2475	301	0	Lean Adj. Tune	Field Gas	8/6/1999	27.00	175.00	16.00
Caterpillar	G398-TAHC	713	0	NSCR	Field Gas	12/15/1997	0.60	87.00	0.16
Caterpillar	G398-TAHC	713	0	NSCR	Field Gas	10/1/1999	4.00	48.00	1.10
Cummins	NT855G4	375	1	None	JP-5	4/15/1993	638.00		
Caterpillar	3306DITA	200	1	None	JP-5	4/15/1993	428.00		
Cummins	NT855G4	375	1	None	JP-5	4/15/1993	503.00		
Cummins	NT855G4	375	1	None	JP-5	5/11/1995	653.00		
Caterpillar	3306DITA	200	1	None	JP-5	5/11/1995	546.00		

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SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
GMC	471	140	1	None	JP-5	12/15/1992	507.00		
GMC	671	160	1	None	JP-5	12/15/1992	594.00		
GMC	671	160	1	None	JP-5	12/15/1992	293.00		
GMC	671	160	1	None	JP-5	12/15/1992	578.00		
GMC	471	140	1	None	JP-5	2/1/1995	397.00		
GMC	671	160	1	None	JP-5	2/1/1995	632.00		
GMC	671	160	1	None	JP-5	2/1/1995	484.00		
GMC	671	160	1	None	JP-5	2/1/1995	359.00		
Caterpillar	3306DITA	200	1	None	JP-5	5/12/1997	637.00		
Cooper	8SGTB	1300	1	NOx clean-burn; CO and ROC catalytic conv.	Nat Gas	1/28/1999	42.60	0.76	11.20
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	4/13/1994	34.40	286.00	149.40
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	12/14/1992	38.00	303.00	10.38
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/15/1992	112.00	84.00	123.00
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	2/3/1994		330.00	161.90
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	12/16/1993	38.94	420.30	253.70
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	2/3/1994	59.60	88.47	94.85
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	2/4/1994	70.00	78.00	107.00
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/15/1993	85.70	90.45	202.03
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/25/1992	5.64	1051.00	5.86
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/25/1992	6.51	913.88	9.31
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/25/1992	13.36	545.61	11.25
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/25/1992	2.40	1097.00	5.48
Ingersoll Rand	LVG-82	650	0		PUC NG	9/25/1992	18.22	605.17	6.83
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/25/1992	11.87	502.03	4.99
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/25/1992	29.78	1320.12	29.78
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	4/7/1994	8.42	833.15	6.21
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/1/1993	1.72	1058.00	6.16
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/31/1993	24.02	793.00	13.35
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/1/1993	3.43	850.00	5.76
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/30/1993	32.00	279.00	6.53
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/2/1993	3.00	1232.00	4.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/31/1993	12.00	1213.00	15.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/14/1994	8.52	1080.00	4.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/15/1994	2.71	842.00	2.16
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/14/1994	5.74	562.00	5.64
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/15/1994	43.00	835.00	3.05
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/13/1994	23.00	717.00	6.34
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/16/1994	13.00	1211.00	1.41
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/13/1994	21.40	768.00	9.46
Cooper Bessemer	GMVA-12	2172	1	Clean Burn Combustion NOx abatement system	PUC NG	12/17/1991			
Waukesha	F2895GU	275	0	PSC	PUC NG	12/3/1993	38.30	139.00	17.70
Waukesha	F2895GU	275	0	PSC	PUC NG	12/2/1993	29.90	156.00	30.70
Waukesha	F2895GU	275	0	PSC	PUC NG	12/2/1993	40.70	172.00	46.60

TABLE D-3

SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	VRG220U	48	0	NSCR	PUC NG	9/8/1995	2.00	4153.00	72.00
Waukesha	VRG220U	48	0	NSCR	PUC NG	4/4/1994	0.34	49.93	24.77
Waukesha	6-MZA-683	58	0	Lean burn adj	PUC NG	9/2/1993	35.00	172.00	66.00
Cooper Bessemer	GMV-10C	1100	1	TC and Cleanburn Burners	PUC NG	9/5/1995	26.00	273.00	435.00
Cooper Bessemer	GMV-10C	1100	1	TC and Cleanburn Burners	PUC NG	8/12/1994	37.74	141.69	378.11
Ingersoll-Rand	8XVG	300	0	NSCR	PUC NG	4/12/1994	4.00	340.00	5.70
Ingersoll-Rand	8XVG	440	0	NSCR	PUC NG	4/12/1994	13.60	663.00	4.40
Ingersoll-Rand	8XVG	440	0	NSCR	PUC NG	4/12/1994	16.20	919.00	31.80
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/7/1995	0.09	894.00	45.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/8/1995	1.00	1250.00	110.00
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	9/5/1995	1.00	64.00	8.00
Waukesha	145 GZU	144	0	NSCR	PUC NG	9/6/1995	4.00	856.00	15.00
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	9/6/1995	0.04	862.00	15.00
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	9/6/1995	1.00	64.00	3.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/6/1995	7.00	1923.00	70.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/7/1995	0.24	3638.00	107.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/7/1995	0.14	2371.00	67.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/7/1995	13.00	1804.00	104.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/6/1994	13.40	1763.77	27.50
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/6/1994	10.76	879.85	21.11
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	4/7/1994	9.31	909.83	11.75
Waukesha	145 GZU	144	0	NSCR	PUC NG	4/8/1994	0.22	1019.57	22.11
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	4/7/1994	1.74	124.61	14.05
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	4/7/1994	1.94	81.09	26.47
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/5/1994	1.40	1838.07	7.50
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/5/1994	3.79	656.07	10.34
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/5/1994	5.11	1183.65	20.93
Waukesha	VRG330U	74	0	NSCR	PUC NG	4/6/1994	3.43	410.94	14.22
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	12/13/1995			
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/13/1995			
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/13/1995			
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/29/1995	12.00	919.00	14.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	8/29/1995	3.00	972.00	4.31
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	8/30/1995	9.00	933.00	7.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/1/1995	37.00	959.00	16.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	8/31/1995	15.00	1144.00	4.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/29/1995	8.00	593.00	8.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	8/29/1995	16.00	508.00	12.00
Waukesha	VRG220U	48	0	NSCR	PUC NG	8/29/1997	0.13	1480.23	45.30
Cooper Bessemer	GMV-10C	1100	1	TC and Cleanburn Burners	PUC NG	8/28/1997	10.36	356.94	480.78
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/2/1997	5.62	2266.88	191.98
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/2/1997	4.63	3948.60	129.23
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	8/27/1997	8.94	328.25	5.94
Waukesha	145 GZU	144	0	NSCR	PUC NG	8/28/1997	1.92	125.94	16.67

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SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	8/27/1997	20.27	3015.83	39.39
Waukesha	VRG330U	74	0	NSCR	PUC NG	8/25/1997	9.18	3190.47	115.48
Waukesha	VRG330U	74	0	NSCR	PUC NG	8/26/1997	0.05	849.89	70.56
Waukesha	VRG330U	74	0	NSCR	PUC NG	8/26/1997	1.22	1460.38	95.44
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/10/1996	11.34	975.98	22.74
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/11/1996	1.77	989.64	5.80
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/16/1996	27.21	147.05	6.59
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/12/1996	4.15	1025.04	11.59
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/11/1996	43.12	1268.96	5.17
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/12/1996	5.78	831.61	14.03
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/10/1996	22.06	1167.11	39.56
Waukesha	VRG330U	74	0	NSCR	PUC NG	8/26/1997	0.58	3035.93	178.76
Waukesha	6-WAK-79A	170	0	NSCR	PUC NG	8/28/1997	5.17	459.19	32.51
Ingersoll-Rand	8XVG	300	0	NSCR	PUC NG	4/4/1996	15.10	755.80	11.60
Ingersoll-Rand	8XVG	440	0	NSCR	PUC NG	4/4/1996	5.40	765.50	1.50
Ingersoll-Rand	8XVG	440	0	NSCR	PUC NG	4/4/1992	29.70	868.20	16.10
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/10/1996			
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/4/1997	7.42	644.00	10.36
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/3/1997	3.31	1179.52	8.10
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/4/1997	6.30	1229.61	13.34
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/3/1997	14.02	596.70	6.27
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/3/1997	33.85	942.57	6.12
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/4/1997	13.55	1074.57	17.42
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/5/1997	9.33	1012.87	18.03
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	12/10/1996		332.00	154.00
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	1/7/1998		65.00	101.00
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/10/1996		85.00	48.00
Waukesha	VRG330U	74	0	NSCR	PUC NG	9/16/1999	15.00	1402.00	106.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/17/1998	31.00	1512.00	11.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/5/1997	98.71	1237.16	15.40
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/10/1996		65.00	39.90
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	1/21/1998		91.00	70.00
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	1/7/1998		93.00	332.00
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	1/6/1998		320.00	175.00
Cooper-Bessemer	GMVA-10	1800	1	CB Comb.	PUC NG	12/8/1998	42.90	342.70	
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	12/9/1998		69.20	33.00
Ingersoll-Rand	8SVG	410	0	PSC	PUC NG	1/21/1998		83.80	61.50
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/15/1998	7.00	183.00	16.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/14/1998	40.00	430.00	5.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/15/1998	5.00	929.00	21.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/17/1998	5.00	929.00	21.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/17/1998	5.00	302.00	6.00
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/18/1998	2.00	791.00	6.00
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/20/1999	21.00	1193.00	5.36
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/20/1999	11.00	215.00	4.38
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/22/1999	15.00	620.00	2.20
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/21/1999	18.00	555.00	3.62

TABLE D-3

SANTA BARBARA COUNTY APCD ICE SOURCE TEST DATA

MANUFACTURER	MODEL	MAX CONTINUOUS bhp RATING	rich burn (r)/lean burn (l), r=0, l=1	CONTROLS	FUEL	TEST DATE	NOx (ppmv @ 15% O2)	CO (ppmv) @ 15% O2)	ROC[a] (ppmv @ 15% O2)
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/21/1999	13.00	661.00	3.65
Ingersoll Rand	LVG-82	650	0	NSCR	PUC NG	9/20/1999	16.00	994.00	10.61
Ingersoll Rand	KVG-62	660	0	NSCR	PUC NG	9/21/1999	4.00	888.00	4.33
Ingersoll-Rand	8SVG	440	0	NSCR	PUC NG	4/29/1998	9.00	1264.00	6.00
Ingersoll-Rand	8SVG	440	0	NSCR	PUC NG	4/29/1998	1.00	2248.00	18.00
Ingersoll-Rand	8XVG	300	0	NSCR	PUC NG	4/29/1998	5.00	103.00	6.00
Waukesha	VRG220U	48	0	NSCR	PUC NG	9/17/1999	0.15	344.00	28.00
Caterpillar	3316	4231	0	Lean Burn Tune and Afterburner	Waste Gas	2/25/1999	10.35		0.10
Waukesha	F2895GU	275	0	PSC	Waste Gas	9/16/1997	39.32	172.87	19.24
Waukesha	F2895GU	275	0	PSC	Waste Gas	9/16/1997	37.82	164.98	25.52
Waukesha	F2895GU	275	0	PSC	Waste Gas	9/17/1997	39.94	157.40	26.14
Waukesha	F2895GU	275	0	PSC	Waste Gas	5/19/1999	45.00	131.00	20.00
Waukesha	F2895GU	275	0	PSC	Waste Gas	5/20/1999	39.00	147.00	30.00
Waukesha	F2895GU	275	0	PSC	Waste Gas	5/20/1999	40.00	126.00	12.00

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
Caterpillar	**3516 SITA**	**1150**	**I**	**Natural Gas**	**Turbocharged, Aftercooled**	**1/91**	**290@3%O2**	**318**	**104**	
						3/91		**251**	**83**	
						10/91		**270**	**89**	
						6/92		**659**	**217**	
						10/92		**286**	**94**	
						5/93		**542**	**179**	
						11/93		**298**	**98**	
						5/94		**319**	**105**	
						11/94		**255**	**85**	
						9/95		**246**	**81**	
Caterpillar	**3516 SITA**	**1150**	**I**	**Natural Gas**	**Turbocharged, Aftercooled**	**1/91**	**290@3%O2**	**323**	**107**	
						3/91		**245**	**81**	
						10/91		**292**	**96**	
						6/92		**315**	**104**	
						9/92		**211**	**70**	
						12/92		**220**	**73**	
						5/93		**625**	**206**	
						11/93		**237**	**78**	
						5/94		**347**	**114**	
						11/94		**208**	**68**	
						9/95		**216**	**71**	
Caterpillar	**3516 SITA**	**1150**	**I**	**Natural Gas**	**Turbocharged, Aftercooled**	**4/91**	**290@3%O2**	**183**	**60**	
						10/91		**1088**	**359**	
						12/91		**208**	**69**	
						7/92		**319**	**105**	
						9/92		**241**	**79**	
						10/92		**316**	**104**	
						5/93		**217**	**72**	
						12/93		**201**	**66**	
						5/94		**272**	**90**	
						11/94		**212**	**70**	
						10/95		**194**	**64**	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
Caterpillar	3516 SITA	1150	I	Natural Gas	Turbocharged, Aftercooled	6/92	290@3%O2	327	108	
						9/92		201	66	
						12/92		201	66	
						5/93		228	75	
						12/93		234	77	
						5/94		340	112	
						1/95		180	59	
						10/95		222	73	
Caterpillar	3512 TA-90	860	I	Natural Gas	Turbocharged, Aftercooled	10/90	280@3%O2	387	128	
						1/91		220	73	
						1/92		231	76	
						1/93		256	84	
						6/93		314	104	
						7/93		205	68	
						1/94		251	83	
						8/94		240	79	
						2/95		246	81	
						7/95		238	78	
						12/95		232	77	
Cooper Superior	16 SGTA	2650	I	Landfill Gas	Prechamber	4/91	177@3%O2	220	73	
						12/91		94	31	
						6/92		219	72	
						1/93		125	41	
						7/93		63	21	
						3/94		100	33	
						8/94		123	41	
						4/95		121	40	
Cooper Superior	16 SGTA	2650	I	Landfill Gas	Prechamber	10/92	177@3%O2	134	44	
						1/93		126	42	
						7/93		71	23	
						2/94		113	37	
						8/94		114	38	

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SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						4/95		108	35	
De Laval		1905	I	Digester Gas	SCR	8/90	850@3%O2	72	24	56
						11/91		107	36	67
De Laval		1905	I	Digester Gas	SCR	9/88	859@3%O2	91	30	72
						8/90		74	25	80
						11/91		81	27	85
Caterpillar	3516 TA	1150	I	Natural Gas	Turbocharged, Aftercooled	4/91	280@3%O2	179	59	
						11/91		208	69	
						6/92		237	78	
						11/92		353	116	
						12/92		211	69	
						6/93		180	59	
						1/94		240	79	
						7/94		237	78	
						12/94		191	63	
						7/95		161	53	
						1/96		302	100	
Caterpillar	3516 TA	1150	I	Natural Gas	Turbocharged, Aftercooled	3/92	280@3%O2	231	76	
						6/92		231	76	
						11/92		242	80	
						6/93		179	59	
						1/94		217	72	
						7/94		239	79	
						12/94		320	106	
						7/95		190	63	
						1/96		246	81	
Caterpillar	3516 TA	1150	I	Natural Gas	Turbocharged, Aftercooled	5/98	280@3%O2	179	60	
Caterpillar	G 399	850	I	Natural Gas	Turbocharged, Aftercooled	10/90	275@3%O2	210	69	
						10/91		263	87	
						3/92		697	177	
						5/92		230	76	
						8/92		181	60	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						3/93		262	86	
						10/93		241	79	
						3/94		154	51	
						10/94		187	62	
						5/95		215	71	
						8/95		178	58	
Caterpillar	3512 TA-90LE	860	I	Natural Gas	Turbocharged, Aftercooled	8/92	275@3%O2	223	74	
						10/93		240	79	
						3/94		387	128	
						4/94		287	95	
						7/94		236	78	
						10/94		311	103	
						2/95		233	77	
						8/95		182	60	
Caterpillar	G 399	930	I	Natural Gas	Turbocharged, Aftercooled	10/90	275@3%O2	217	72	
						10/91		254	84	
						3/92		623	205	
						5/92		236	78	
						8/92		183	60	
						10/93		173	57	
						3/94		258	85	
						10/94		142	47	
						5/95		144	48	
						8/95		187	62	
Caterpillar	G 399	930	I	Natural Gas	Turbocharged, Aftercooled	10/91	275@3%O2	272	90	
						8/92		254	84	
						3/93		148	49	
						11/93		185	61	
						3/94		203	67	
						5/95		100	33	
						8/95		224	74	
Caterpillar	G 399	930	I	Natural Gas	Turbocharged, Aftercooled	5/98	275@3%O2	180	60	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
Waukesha	L7042G	674	r	Natural Gas	Maxim Catalyst, A/F cont.	1/88	300@3%O2	3	1	
						1/88		4	1	
						6/89		191	64	
						9/91		57	19	
						3/92		28	9	
Waukesha	L7042G	674	r	Natural Gas	Maxim Catalyst, A/F cont.	6/87	300@3%O2	2	1	
						6/89		20	7	
						9/90		40	13	
						9/91		2326	775	
						12/91		2	1	
						2/92		8	3	
Waukesha	L7042G	674	r	Natural Gas	Maxim Catalyst, A/F cont.	6/87	300@3%O2	1	0	
						6/89		2	1	
						9/90		307	102	
						9/91		208	69	
						12/91		1	0	
						2/92		5	2	
Waukesha	L7042G	674	r	Natural Gas	Maxim Catalyst, A/F cont.	2/98	300@3%O2	167.1	56	
Waukesha	VHP 7100G	674	r	Natural Gas	Englehard Catalyst, A/F con.	6/86	230@3%O2	3	1	
						2/87		0	0	
						5/88		27	9	
						6/89		1196	399	
						8/89		122	41	
						6/90		72	24	
						6/92		133	44	
Waukesha	VHP 7100G	674	r	Natural Gas	Englehard Catalyst, A/F con.	6/86	230@3%O2	2	1	
						2/87		0	0	
						5/88		46	15	
						6/89		528	176	
						8/89		100	33	
						6/90		129	43	
						6/92		115	38	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
Caterpillar	G379 HCNA	329	r	Natural Gas	Johnson-Mattey Catalyst	10/88	245@3%O2	12	4	
						10/91		8	3	
						3/93		14	5	
						11/93		2	1	
						10/94		40	13	
						3/94		11	4	
						8/95		18	6	
Caterpillar	G379 HCNA	329	r	Natural Gas	Johnson Matthey Catalyst	10/91	245@3%O2	4	1	
						2/92		20	7	
						10/93		11	4	
						3/94		32	11	
						10/94		53	18	
						5/95		21	7	
						10/95		109	36	
Caterpillar	G379 HCNA	329	r	Natural Gas	Johnson Matthey Catalyst	10/90	245@3%O2	36	12	
						10/91		4	1	
						3/93		158	53	94.2
						4/93		38	13	
						10/93		4	1	99.8
						11/94		110	37	95
						5/95		188	63	93
						10/95		96	32	96
Caterpillar	G399	950	r	Natural Gas	Englehard Catalyst	4/88	215@3%O2	121	40	
						6/90		920	307	
						8/91		193	64	
						12/91		175	58	
						6/92		135	45	
Caterpillar	G399	950	r	Natural Gas	Englehard Catalyst	2/88	215@3%O2	223	74	
						2/90		368	123	
						6/90		206	69	
						12/91		260	87	
						4/92		149	48	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						6/92		141	47	
Caterpillar	G399	950	r	Natural Gas	Englehard Catalyst	3/88	215@3%O2	159	53	
						2/90		829	276	
						12/91		119	40	
Caterpillar	G399	950	r	Natural Gas	Englehard Catalyst	2/88		168	56	
						2/90		1570	523	
						12/91		372	124	
Caterpillar	G399	915	r	Natural Gas	Englehard Catalyst	2/85	456@3%O2	15	5	
						3/87		3500	1167	
						12/88		1308	436	
						12/89		160	53	
						1/90		334	111	
						2/90		213	71	
						7/91		781	260	
						11/91		71	24	
						8/92		849	283	
						1/93		64	21	
						3/93		1345	448	
						5/93		6	2	
						9/93		12	4	
						2/94		42	14	
Caterpillar	G399	915	r	Natural Gas	Englehard Catalyst	9/94	456@3%O2	146	49	
						3/95		261	87	
						8/95		0	0	
						1/96		6	2	
Caterpillar	G399	915	r	Natural Gas	Englehard Catalyst	11/86	456@3%O2	330	110	
						3/87		83	28	
						12/88		1358	453	
						12/89		814	271	
						1/90		388	129	
						2/90		257	86	
						7/91		726	242	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						11/91		173	58	
						8/92		995	332	
						1/93		0	0	
						2/93		2	1	
						9/93		80	27	
						2/94		243	81	
						9/94		20	7	
						4/95		0	0	
						8/95		9	3	
						1/96		24	8	
Caterpillar	G398NA-HCR	499	r	Natural Gas	Englehard Cat., A/F control	3/85	285	137	46	95.3
						7/91		150	50	
						8/92		394	131	
						2/93		89	30	
						3/93		1091	364	
						4/93		112	37	
						9/93		105	35	
						3/94		84	28	
						8/94		103	34	
						3/95		0	0	
						2/96		12	4	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Cat., A/F	5/88	230@3%O2	6	2	99.8
						4/90		81	27	
						5/90		40	13	
						12/91		7	2	
						6/92		29	10	
						12/92		10	3	
						5/93		10	3	
						1/94		12	4	
						6/94		12	4	
						1/95		63	21	
						6/95		16	5	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						11/95		183	61	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Cat., A/F	5/88	230@3%O2	8	3	99.7
						4/90		154	51	
						5/90		104	35	
						6/90		116	39	
						7/90		13	4	
						12/91		11	4	
						1/92		43	14	
						6/92		54	18	
						5/93		15	5	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Cat., A/F	1/94	230@3%O2	20	7	
						6/94		30	10	
						2/95		223	74	
						6/95		20	7	
						12/95		11	4	
Waukesha	VHP 7100G	1130	r	Natural Gas	Waukesha Catalyst, A/F	7/89	230@3%O2	109	36	
						10/90		193	64	
						3/91		197	66	
						6/92		178	59	
						3/93		1	0	
						5/93		6	2	
						3/94		110	37	
						12/94		51	17	
						5/95		25	8	
						9/95		28	9	
Waukesha	VHP 7100G	1130	r	Natural Gas	Waukesha Catalyst, A/F	7/89	230@3%O2	110	37	
						7/90		208	69	
						6/92		172	57	
						5/93		204	68	
						3/94		13	4	
						12/94		7	2	
						5/95		23	8	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						9/95		89	30	
Waukesha	F 2695G	463	r	Natural Gas	Engelhard Catalyst	4/89	300@3%O2	67	22	
						11/89		52	17	
Waukesha	F 2695G	463	r	Natural Gas	Engelhard Catalyst	4/89	300@3%O2	148	49	
						11/89		368	123	
						12/89		48	16	
Waukesha	F 2695G	463	r	Natural Gas	Engelhard Catalyst	2/89	180@3%O2	700	233	
						3/89		40	13	
Waukesha	F 2695G	463	r	Natural Gas	Engelhard Catalyst	3/89	180@3%O2	400	133	
						5/90		97	32	
						5/90		109	36	
Waukesha	VHP 7100G	1131	r	Natural Gas	Maxim Catalyst	12/90	303@3%O2	45	15	
					Engelhard Catalyst	12/91		54	18	
						6/92		307	102	
						10/92		51	17	
						6/93		33	11	
						2/94		107	36	
						6/94		131	44	
						12/94		154	51	
						7/95		20	7	
						11/95		20	7	
Waukesha	VHP 7100G	1131	r	Natural Gas	Maxim Catalyst	12/89	303@3%O2	935	312	
					Engelhard Catalyst	2/90		132	44	
						6/92		1156	385	
						10/92		60	20	
						6/93		22	7	
						3/94		75	25	
						6/94		136	45	
						12/94		78	26	
						7/95		90	30	
						11/95		89	30	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Catalyst	12/84	?	74	25	

Table D-4

SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
						6/87	240@3%O2	656	219	
						4/88		1692	564	
						9/88	212@3%O2	132	44	
						12/89		2	1	
						12/91		26	9	
						7/92		4	1	
						1/93		6	2	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Catalyst	7/93	212@3%O2	18	6	
						1/94		3	1	
						9/94		150	50	
						2/95		5	2	
						7/95		102	34	
						1/96		9	3	
Caterpillar	G399	915	r	Natural Gas	Johnson Matthey Catalyst	2/85	?	23	8	
						1/87	240@3%O2	463	154	
						4/88		1692	564	
						9/88	212@3%O2	4	1	
						12/89		386	129	
						4/90		4	1	
						5/91		52	17	
						7/92		3	1	
						1/93		3	1	
						7/93		30	10	
						2/94		87	29	
						9/94		312	104	
						2/95		8	2	
						7/95		134	45	
						1/96		4	1	
Caterpillar	G398 HCNA	499	r	Natural Gas	Maxim Catalyst, A/F cont.	7/89	292@3%O2	470	157	
						5/90		18	6	
					or	9/90		21	7	
						5/92		418	139	

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SAN DIEGO COUNTY APCD
SOURCE TEST DATA

MANUFACTURER	MODEL	HORSE POWER	R/L	FUEL	CONTROLS	TEST DATE	NOX LIMIT	NOX 3%O2	NOX 15%O2	NOX % Reduction
					Radian Hybrid System	10/92		5	2	99.9
						6/93		47	15	98.7
						2/95		15	5	99.6
						7/95		102	34	96.8
						11/95		80	27	97
Caterpillar	G398 HCNA	499	r	Natural Gas	Maxim Catalyst, A/F cont.	2/88	292@3%O2	156	52	94
						7/89		400	133	
						5/90		9	3	
						5/92		57	19	
						11/92		77	26	95
						1/93		49	16	98
						8/94		12	4	99.5
						2/95		6	2	100
						7/95		15	5	99
						11/95		3	1	100
Caterpillar	G398 HCNA	499	r	Natural Gas	Maxim Catalyst, A/F cont.	2/88	292@3%O2	6	2	99.8
						7/89		1064	355	
						6/90		558	186	
						5/92		6	2	
						11/92		64	21	96
						1/93		128	43	
						6/93		378	126	87
						3/94		30	10	98.7
						2/95		13	4	99
						7/95		206	69	92
						11/95		6	2	100

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
767			Y			NAT. GAS	4/7/1998				140.6	152.2	
767			Y			NAT. GAS	4/7/1998				19.5	101.1	
767			Y			NAT. GAS	4/7/1998				123.3	262.5	
465		Y	Y			NAT. GAS	2/25/1997				6	35.1	
465		Y	Y			NAT. GAS	10/6/1998				17	112	
160						NAT. GAS	4/2/1998	9.7	343		22	284	
1320						NAT. GAS	9/10/1996				1114	54	
1320						NAT. GAS	9/10/1996				1202	41	
1320						NAT. GAS	1/4/1996	5.6	2554		510	63	
1320						NAT. GAS	1/4/1996	5.6	2488		576	56	
140	Y		Y			NAT. GAS	10/7/1997				6.82	930	
140	Y		Y			NAT. GAS	8/18/1998				1.5	694.9	

San Joaquin Valley Unified APCD IC Engine Source Test Data

	CONTROLS												
HP	LEAN	RICH	CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
55	Y		Y			NAT. GAS	10/8/1997				0.2	1.9	
80	Y		Y			NAT. GAS	10/8/1997				1	837	
160	Y		Y			NAT. GAS	10/7/1997				13.7	144	
100	Y		Y			NAT. GAS	10/7/1997				2.3	6.2	
165	Y		Y			NAT. GAS	10/7/1997				7.6	53.9	
65	Y		Y			NAT. GAS	8/18/1998				10.6	447.8	
80	Y		Y			NAT. GAS	10/8/1997				0.85	5.1	
50			Y			NAT. GAS	10/8/1997				1	125	
225			Y			NAT. GAS	4/22/1997		238		10.6	16	
225			Y			NAT. GAS	4/21/1997		218		11	34	
225			Y			NAT. GAS	4/21/1997		258		16.9	100	
1441			Y			NAT. GAS	5/21/1997				2.9	6.9	

San Joaquin Valley Unified APCD IC Engine Source Test Data

			CONTROLS										
HP	LEAN	RICH	CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
1411			Y			NAT. GAS	5/21/1998				2.5	11.1	
765			Y			NAT. GAS	2/13/1997				19.6	270.7	
765			Y			NAT. GAS	2/13/1997				9.2	141.6	
765			Y			NAT. GAS	2/13/1997				53.4	243.4	
800			Y			NAT. GAS	12/3/1996				1.4	53	
800			Y			NAT. GAS	12/9/1997				0.87	31	
800			Y			NAT. GAS	12/3/1996				2	51	
800			Y			NAT. GAS	12/9/1997				2.2	90	
1060	Y					NAT. GAS	9/19/1997	10.1	2422	205	65.02	365	
330				Y		NAT. GAS	11/21/1996	8.2			40.2	96.6	
330				Y		NAT. GAS	11/12/1997	7.9			24	88	
330				Y		NAT. GAS	11/21/1996	12.8			35.8	112.3	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
330				Y		NAT. GAS	11/12/19 97	12.4			28	101	
165						NAT. GAS	1/4/1996	0.16			2.9	245	
23						NAT. GAS	11/25/19 97	0.06			11.8	2129	
165		Y	Y			NAT. GAS	1/4/1996	0.15			15.3	245.4	
165		Y	Y			NAT. GAS	1/4/1996	0.1			15.2	508	
165		Y	Y			NAT. GAS	1/4/1996	0.12			61.4	1656	
120			Y			NAT. GAS	1/4/1996	0.1			25	46.9	
120		Y	Y			NAT. GAS	1/4/1996	0.13			16.5	1085	
360		Y	Y			NAT. GAS	10/30/19 96	0.01			35.9	1310	
400		Y	Y			NAT. GAS	10/31/19 96	0.01			4.6	837	
400		Y	Y			NAT. GAS	12/16/19 97	0.1			2.4	125.7	
400		Y	Y			NAT. GAS	10/31/19 96	0.01			5.2	1006	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
370		Y	Y			NAT. GAS	10/30/1996	0.03			28.5	320	
370		Y	Y			NAT. GAS	12/12/1997	0.1			14.44	71	
370		Y	Y			NAT. GAS	10/30/1996	0.05			24.3	193	
370		Y	Y			NAT. GAS	10/31/1996	0.03			10.8	98.5	
370		Y	Y			NAT. GAS	12/15/1997	0.72			18.2	19.7	
370		Y	Y			NAT. GAS	12/12/1997	0.3			39.2	238	
2000	Y					NAT. GAS	10/31/1996	11.4			32.5		
2000	Y					NAT. GAS	12/16/1997	9.2			113	201	
2000	Y					NAT. GAS	10/30/1996	12			21		
2000	Y					NAT. GAS	12/15/1997	9.8			56.6	216	
2000	Y					NAT. GAS	10/31/1996	10.7			39.7		
2000	Y					NAT. GAS	12/15/1997	10.7			21.3	305	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
455	Y					NAT. GAS	10/30/1996	10.2			45.4		
1100	Y					NAT. GAS	6/17/1996	11.2	1804	135	32	392	466
1100	Y					NAT. GAS	6/24/1997	10.3	2146	7.9	50	738	50
1100	Y					NAT. GAS	6/19/1996	11	1720	126	87	414	440
1100	Y					NAT. GAS	6/24/1997	10.9	2352	8.1	47	477	
1100	Y					NAT. GAS	6/17/1996	11.2	1900	142	56	403	309
1100	Y					NAT. GAS	6/25/1997	10.7	2464	8.6	94	581	34
825	Y					NAT. GAS	6/18/1996	10.9	1434	102	48	325	453
825	Y					NAT. GAS	6/25/1997	10.2	1343	4.9	60	575	119
825	Y					NAT. GAS	6/19/1996	10.9	1375	102	72	451	382
825	Y					NAT. GAS	6/25/1997	10.8	1271	4.4	62	465	82
825	Y					NAT. GAS	8/30/1996	11.3	1334	109.7	98	371	382

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
825	Y					NAT. GAS	6/24/1997	12.3	1660	4.9	22	445	
825	Y					NAT. GAS	8/7/1997	12.2	1680	5.2			
600	Y					NAT. GAS	7/22/1997	13.2			145.6	79	
600	Y					NAT. GAS	7/23/1997	13.7			373	149	
800	Y					NAT. GAS	6/4/1996	14			130	86	
800	Y					NAT. GAS	7/23/1997	14.3			135.2	85	
660	Y					NAT. GAS	6/4/1996	14.5			117	112	
660	Y					NAT. GAS	7/22/1997	13			63	169	
300	Y			Y		NAT. GAS	10/1/1996	8.1	626	64	19.6		
63		Y	Y			NAT. GAS	1/10/1996						
63		Y	Y			NAT. GAS	1/9/1996				0	75	
63		Y	Y			NAT. GAS	1/9/1996				0.1	257	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	CONTROLS					FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
	LEAN	RICH	CAT	PSC	PCC								
63		Y	Y			NAT. GAS	11/20/1996	0.14			0.1	128	
300	Y			Y		NAT. GAS	10/1/1996	7.7	607	64	39.7		
650	Y					NAT. GAS	8/14/1996	10	1000	100.8	34		
650	Y					NAT. GAS	7/9/1997				43		
650	Y					NAT. GAS	8/13/1996	9.6	962	100.8	84		
650	Y					NAT. GAS	7/8/1997				42		
650	Y					NAT. GAS	8/13/1996	9.6	969	100.8	132		
650	Y					NAT. GAS	7/8/1997				28		
157		Y	Y			NAT. GAS	1/10/1996	0.02			0.2	770	
157		Y	Y			NAT. GAS	11/20/1996	0.06			1	803	
157		Y	Y			NAT. GAS	10/21/1997				55	1551	
157		Y	Y			NAT. GAS	1/10/1996						

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
157		Y	Y			NAT. GAS	1/10/1996				0	476	
104		Y	Y			NAT. GAS	1/11/1996				0.1	34.8	
104		Y	Y			NAT. GAS	11/19/1996				0.1	731	
104		Y	Y			NAT. GAS	10/21/1997				0.2	303	
157		Y	Y			NAT. GAS	1/11/1996				0.2	445	
1100	Y					NAT. GAS	8/23/1996	10.5	1876	165	39.4	289	
1100	Y					NAT. GAS	8/23/1996	10.3	1948	174	52	288	
778		Y	Y			NAT. GAS	9/30/1996	0.1			24.2	153	
778		Y	Y			NAT. GAS	9/30/1996	0.1			15.7	404	
778		Y	Y			NAT. GAS	9/30/1996	0.12			25	241	
778		Y	Y			NAT. GAS	9/30/1996	0.11			21.5	1132	
778		Y	Y			NAT. GAS	10/1/1996	0.1			15	743	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
946		Y	Y			NAT. GAS	10/1/1996	0.1			17	460	
946		Y	Y			NAT. GAS	10/1/1996	0.12			14	780	
778		Y	Y			NAT. GAS	10/2/1996	0.12			14	166	
778		Y	Y			NAT. GAS	10/2/1996	0.4			34	495	
778		Y	Y			NAT. GAS	10/2/1996	0.1			10	267	
473		Y	Y			NAT. GAS	10/1/1996	0.13			9.7	236	
473		Y	Y			NAT. GAS	10/3/1996	0.3			74	1215	
473		Y	Y			NAT. GAS	10/3/1996	0.3			14	334	
615						NAT. GAS	10/3/1996	10	1069		107	443	
473		Y	Y			NAT. GAS	10/1/1996	0.2			51.4	656	
4000	Y				Y	NAT. GAS	5/2/1996	13.5	10571	577	48	476	
4000	Y				Y	NAT. GAS	6/18/1996	13.7	10700	559	91	545	813

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	CONTROLS: LEAN	CONTROLS: RICH	CONTROLS: CAT	CONTROLS: PSC	CONTROLS: PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
4000	Y				Y	NAT. GAS	5/16/1996	13.5	10780	580	86	415	
1000	Y				Y	NAT. GAS	4/11/1996	10	2089	166			
1000	Y				Y	NAT. GAS	3/20/1997	10.2	1916	149	28.5	278	
1000	Y				Y	NAT. GAS	4/11/1996	10.5	2113	160			
1000	Y				Y	NAT. GAS	3/20/1997	10.4	2141	164	29	352	
1000	Y				Y	NAT. GAS	4/11/1996	10.2		166.5			
1000	Y				Y	NAT. GAS	5/9/1996	10.4	2030	155			
1000	Y				Y	NAT. GAS	6/25/1996	9.5	1993	166	71	448	449
1000	Y				Y	NAT. GAS	3/20/1997	9.9	2067	165	27.6	233	
450		Y	Y			NAT. GAS	1/10/1996	0.05			14.6	220	
670						BIOGAS	12/3/1997	9.31	1164	4.15			
100			Y			NAT. GAS	1/30/1996	0			9.3	100	11

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
100			Y			NAT. GAS	3/27/1996	0.01			12	118	10
100			Y			NAT. GAS	1/30/1996	0			21	174	15
100			Y			NAT. GAS	1/30/1996				52	193	10
100			Y			NAT. GAS	1/31/1996				207	50	
500		Y	Y			NAT. GAS	6/18/1996	0	600		8	1279	
86		Y				NAT. GAS	6/19/1996	6.8	190	13.3	58	253	
240	Y					NAT. GAS	2/27/1996	7	204	11.3			
240	Y					NAT. GAS	2/27/1996	7.3	183	10			
240	Y					NAT. WAST	3/6/1996	7.2	198	10.8			
713		Y	Y			NAT. GAS	9/25/1996	0.01			21	305	
208		Y	Y			NAT. GAS	10/24/1996	0.1			28.7	351	
208		Y	Y			NAT. GAS	11/13/1997	0.01			5.9	167	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
208		Y	Y			NAT. GAS	10/25/1996	0.1			38	44	
208			Y			NAT. GAS	11/17/1997	0.02			7	238	
208		Y	Y			NAT. GAS	10/24/1996	0.15			22.6	760	
208		Y	Y			NAT. GAS	11/17/1997	0.05			5.7	102	
316		Y	Y			NAT. GAS	10/23/1996	0.01			28.3	23	
316		Y	Y			NAT. GAS	11/18/1997	0.34			17	47	
316		Y	Y			NAT. GAS	10/23/1996	0.01			7	106	
316		Y	Y			NAT. GAS	11/13/1997	0.07			9	175	
216		Y	Y			NAT. GAS	10/23/1996	0.4			24	673	
316		Y	Y			NAT. GAS	10/24/1996	0.01			25.2	380	
316		Y	Y			NAT. GAS	11/13/1997	0.06			7	17	
316		Y	Y			NAT. GAS	10/23/1996	0.1			16.3	853	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
216		Y	Y			NAT. GAS	10/25/1996	0.1			16	85	
316		Y	Y			NAT. GAS	11/13/1997	0.03			4	105	
206		Y	Y			NAT. GAS	10/25/1996	0.1			14	72	
316		Y	Y			NAT. GAS	11/13/1997	0.2			13.6	57	
162		Y	Y			NAT. GAS	11/17/1997	0.05			20	161	
208		Y	Y			NAT. GAS	10/24/1996	0.2			54	582	
208		Y	Y			NAT. GAS	11/17/1997	0.2			22.3	344	
316		Y	Y			NAT. GAS	10/23/1996	0.01			24.9	556	
162		Y	Y			NAT. GAS	11/17/1997	0.01			12	92	
208		Y	Y			NAT. GAS	10/25/1996	0.1			20	91	
208		Y	Y			NAT. GAS	11/17/1997	0.01			6.6	214	
88	Y					NAT. GAS	7/15/1996	6.2			106.6		

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
330		Y	Y			NAT. GAS	12/11/1996	0.4			43	533	
498		Y	Y			NAT. GAS	12/11/1996				63	656	
498		Y	Y			NAT. GAS	12/18/1996	0.14			0.37	3.4	
525		Y	Y			NAT. GAS	6/7/1996	0.04	499	74.63	35	515	23
525		Y	Y			NAT. GAS	8/22/1997	0.25	193	30	16.6	170	5
525		Y	Y			NAT. GAS	5/1/1996	0.17					
525		Y	Y			NAT. GAS	8/22/1997	0.26	159	24.7	36.8	176.8	10.7
525		Y	Y			NAT. GAS	6/7/1996	0.15	501	74.6	125	427	34
525		Y	Y			NAT. GAS	8/21/1997	0.2	278	43	9.9	161.7	1.9
		Y	Y			NAT. GAS	5/1/1996	0.03			11.3	47	5.1
525		Y	Y			NAT. GAS	8/21/1997	0.25			12.9	126.2	6.8
220	Y					NAT. GAS	7/1/1996	8.3			19	86	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
225	Y					NAT. GAS	7/2/1996	8.65			24	148	
220						NAT. GAS	7/2/1996	8.1			6.5	208	
1024		Y	Y			NAT. GAS	6/20/1996	0.02	1078	210	169		
1024		Y	Y			NAT. GAS	2/4/1997	0.05	1272	241	31		
360	Y					NAT. GAS	5/9/1996	15.8			20.5	268	
450	Y					NAT. GAS	5/7/1996	16			14.3	447	
450	Y					NAT. GAS	5/7/1997	16.5			6.6	532	
450	Y					NAT. GAS	5/7/1996	15.3			25	276	
450	Y					NAT. GAS	5/7/1997	16.5			19.7	384	
230	Y					NAT. GAS	7/9/1996	15.3			47.7	201	106
230	Y					NAT. GAS	7/11/1997	14.9			57	160	
280	Y					NAT. GAS	7/9/1996	14.8			16.9	151	115

San Joaquin Valley Unified APCD IC Engine Source Test Data

			CONTROLS										
HP	LEAN	RICH	CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
230	Y					NAT. GAS	7/11/1997	14.9			18.9	134.6	
1052		Y	Y			NAT. GAS	8/9/1996	0.1	961	152.2	3.3	439	49
1052		Y	Y			NAT. GAS	5/2/1997	0.15	837	5.43	6.9	103	
1052		Y	Y			NAT. GAS	8/9/1996	0.12	928	147	169	1241	76
1052			Y			NAT. GAS	5/2/1997	0.5	1000	6.37	1.6	112	
500		Y	Y			NAT. GAS	8/8/1996	0.12			20.2	64.6	
500			Y			NAT. GAS	5/1/1997	0.06			25.1	133.5	
500		Y	Y			NAT. GAS	8/8/1996	0.13			14.1	320	
500			Y			NAT. GAS	5/1/1997	0.2			26.9	958	
200		Y	Y			NAT. GAS	2/28/1996	0.07			2.3	195	
200			Y			NAT. GAS	5/1/1997	0.1			46	13	
200		Y	Y			NAT. GAS	2/28/1996	0.16			16.9	599	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
200			Y			NAT. GAS	4/30/1997	0.3			30	72	
200		Y	Y			NAT. GAS	2/5/1996	0.08			1.1	399	
200		Y	Y			NAT. GAS	2/25/1997	0.1			3.2	548	
147		Y	Y			NAT. TEOR	4/22/1997	2.8	152		363	162	
100		Y				NAT. GAS	6/18/1996	1.2	68		115	365	
60		Y				NAT. GAS	6/18/1996	6.2			44	227	
88		Y				NAT. TEOR	4/22/1997	0.1			35	300	
		Y	Y			NAT. GAS	12/19/1996	0.02	90		34	558	140
		Y	Y			NAT. GAS	12/20/1996	0.4	101		11	1967	50
		Y	Y			NAT. GAS	12/19/1996	0.03	148		15	204	62
		Y	Y			NAT. GAS	12/20/1996	0.12	149		20	683	217
		Y	Y			NAT. GAS	1/30/1997	0.01	89		11.4	814	250

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
660		Y	Y			NAT. GAS	6/21/199 6	0.03	634	86	38	392	165
660		Y	Y			NAT. GAS	8/14/199 7	0.12	445	60.6	1.9	286	33
625		Y	Y			NAT. GAS	6/21/199 6	0.29	720	97	136	530	52
640		Y	Y			NAT. GAS	8/14/199 7	0.14	618	84	24	113.9	40.2
208		Y	Y			NAT. GAS	1/8/1996				24.4	413	
208		Y	Y			NAT. GAS	1/27/199 7	0.1			39	147	
208		Y	Y			NAT. GAS	1/8/1996				22.8	105	
208		Y	Y			NAT. GAS	1/27/199 7	0.02			30	147	
208		Y	Y			NAT. GAS	1/8/1996				43.7	187	
208		Y	Y			NAT. GAS	1/27/199 7	0.02			37	331	
208		Y	Y			NAT. GAS	1/8/1996				8.5	158	
208		Y	Y			NAT. GAS	1/27/199 7	0.02			0.2	24	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
208		Y	Y			NAT. GAS	1/8/1996	0.27			5.6	523	
208		Y	Y			NAT. GAS	1/27/1997	0.02			5.1	73	
105	Y					NAT. GAS	9/3/1997	16.5			301	123	
105	Y					NAT. GAS	9/5/1997	15.2			110	100	
360	Y					NAT. GAS	9/3/1997	14			89.6	266	
360	Y					NAT. GAS	9/3/1997	16.4			70.7	470	
1000		Y	Y			NAT. GAS	9/12/1996	0.01	694	114	83	1468	
1340		Y	Y			NAT. GAS	7/9/1997	0.1	695	4.8	139	1438	
1000		Y	Y			NAT. GAS	9/12/1996	0.04	1137	186.6	105	690	
1340		Y	Y			NAT. GAS	7/9/1997	0.1	730	5.1	11	861	
1340		Y	Y			NAT. GAS	11/13/1996	0.03	800	131.4	9.4	745	
1340		Y	Y			NAT. GAS	6/26/1997	0.1	1116	7.7	10	530	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	CONTROLS					FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
	LEAN	RICH	CAT	PSC	PCC								
1340		Y	Y			NAT. GAS	11/13/1996	0.01	799	131	68	633	
1340		Y	Y			NAT. GAS	6/26/1997	0.1	814	5.6	70	491	
115	Y					NAT. GAS	6/14/1996	15.7			29.7	189	
115	Y					NAT. GAS	4/16/1997	19			41.2	102	
185			Y			NAT. GAS	4/4/1996	8.3			37.2	10.2	
145			Y			NAT. GAS	4/4/1996	7.7			15.7	10.3	191
145			Y			NAT. GAS	10/23/1997	0.06			8.1	606	0.5
145			Y			NAT. GAS	4/4/1996	7.85			15.6	1.35	290
145			Y			NAT. GAS	10/23/1997	0.1					23.6
660		Y	Y			NAT. GAS	11/13/1996	0.12			86.2	508	
550	Y					NAT. GAS	11/12/1996	8.2	579	68.1	68.9		
550	Y					NAT. GAS	11/4/1997				87	126	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	CONTROLS					FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
	LEAN	RICH	CAT	PSC	PCC								
300	Y			Y		NAT. GAS	11/15/1996	9.3			44		
150		Y	Y			NAT. GAS	11/12/1996	1.3	413	74.7	9.3	236	
150		Y	Y			NAT. GAS	11/5/1997	0.1			12	846	
330		Y	Y			NAT. GAS	11/12/1996	0.09	300	57.7	30	234	
330		Y	Y			NAT. GAS	11/5/1997	0.1			25	525	
1232	Y					NAT. GAS	7/26/1996	10.3	1714	137	47	327	
1232	Y					NAT. GAS	7/26/1996	10.6	1445	113	45	381	
150		Y	Y			NAT. GAS	11/20/1996	0.07			0	732	
150		Y	Y			NAT. GAS	11/18/1997	0.97			24	828	
342		Y	Y			NAT. GAS	12/17/1996	0.3			30.1	569	
342			Y			NAT. GAS	11/5/1997				49	1256	
5500	Y				Y	NAT. GAS	5/23/1996	13.7	13541	710	44	479	295

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
			CONTROLS										
5500	Y				Y	NAT. GAS	4/29/1997	13.5	11850	660	76	304	
5500	Y				Y	NAT. GAS	5/23/1996	13.6	11260	619	114	597	569
5500	Y				Y	NAT. GAS	4/29/1997	14	12280	615	105	416	
2000	Y				Y	NAT. GAS	5/30/1996	13.5	13104	725	134		
5500	Y				Y	NAT. GAS	5/1/1997	13.7	12650	658	114	342	
2000	Y				Y	NAT. GAS	5/30/1996	12.9	6553	389	29	380	
2000	Y				Y	NAT. GAS	5/1/1997	12.8	6250	371	86	258	
5500	Y				Y	NAT. GAS	6/13/1996	14	15934	805			
5500	Y				Y	NAT. GAS	5/15/1997	12.8		731	121	301	47
5500	Y				Y	NAT. GAS	6/25/1996	14.6	17700	814	93	574	716
5500	Y				Y	NAT. GAS	6/10/1997	14	15800	804	98	455	
5500	Y				Y	NAT. GAS	5/28/1996	14.5	12313	580	100	498	298

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
5500	Y				Y	NAT. GAS	5/13/1997	13.4		573	84	363	145
2000	Y				Y	NAT. GAS	5/28/1996	11.7	5314	360	133	300	324
2000	Y				Y	NAT. GAS	5/13/1997	11.4		365	83	149	20
4000	Y				Y	NAT. GAS	3/12/1996	13	9501	549.2	48.1		
4000	Y				Y	NAT, GAS	2/20/1997	15.3	10300	430	12.5	213	
4000	Y				Y	NAT. GAS	3/14/1996	13.1	8218	467.8	33.3		
4000	Y				Y	NAT. GAS	2/25/1997	13.2	6787	385.2	58	175	
1000	Y			Y		NAT. GAS	3/14/1996	8.3	2093	192.7	59.7		
1000	Y			Y		NAT. GAS	2/25/1997	8.5	2285	209	57	98	
1000	Y			Y		NAT. GAS	3/12/1996	7.7	1958	189.4	63.2		
1000	Y			Y		NAT. GAS	2/20/1997	8.1		199	73	113	
1000	Y			Y		NAT. GAS	3/19/1996	8.4	1958	179	52.2		

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
1000	Y			Y		NAT. GAS	2/27/1997	8.3	1785	164	67.5	146	
4000	Y				Y	NAT. GAS	4/24/1997	13.1	9165	521	83	361	
490		Y	Y			NAT. GAS	5/14/1996	0.01		65			
490		Y	Y			NAT. GAS	5/14/1996	0.06	430	66	15		
490		Y	Y			NAT. GAS	4/22/1997	0.05	386	59	52	698	
1000	Y			Y		NAT. GAS	3/28/1996	8.2	1453	135.6	101		
1000	Y			Y		NAT. GAS	3/13/1997	7.6	2000	196	58.5	103	
1000	Y			Y		NAT. GAS	4/16/1996	8.8	3270	198	131		
1000	Y			Y		NAT. GAS	6/5/1997	8.7	2395	215	58	150	
1000	Y			Y		NAT. GAS	3/21/1996	7.8	1271	122.5	45.5		
1000	Y			Y		NAT. GAS	3/4/1997	9.3	1987	167	28	119	
650		Y	Y			NAT. GAS	3/21/1996	0.01	436	66.9	1.4		

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	CONTROLS LEAN	RICH	CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
650		Y	Y			NAT. GAS	2/27/1997	0.01	510	77.6	23.7	619	
1000	Y			Y		NAT. GAS	5/2/1996	7.7	2234	197	110		
1000	Y			Y		NAT. GAS	4/17/1997	7.9	1750	168	85	139	
2000	Y				Y	NAT. GAS	6/11/1996	12	5922	388			
4000	Y				Y	NAT. GAS	4/24/1997	12.7	8830	527	74	343	
2000	Y				Y	NAT. GAS	5/29/1997	11.6		382	47	224	53
4000	Y				Y	NAT. GAS	4/17/1997	12.4	8617	550	78.5	322	
1000	Y			Y		NAT. GAS	6/19/1996	8.5	1784	161	70		
1000	Y			Y		NAT. GAS	6/5/1997	7.4	1705	170	67	77	
650		Y	Y			NAT. GAS	4/2/1996	0.3	1474	111	30		
650		Y	Y			NAT. GAS	3/18/1997	0.02	570	87.6	12.5	372	
650		Y	Y			NAT. GAS	4/9/1996	0.36	1252	93			

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
650		Y	Y			NAT. GAS	4/1/1997	0.34	664	99	181	74	
650		Y	Y			NAT. GAS	4/24/1997	0.35	731	110	14	184	
650		Y	Y			NAT. GAS	4/16/1996	1.1	2380	198.6	19.3		
650		Y	Y			NAT. GAS	4/1/1997	0.75		127	60	307	
1000	Y			Y		NAT. GAS	3/26/1996	8	1705	160	42.1		
1000	Y			Y		NAT. GAS	3/6/1997	9.9	2093	169	26	156	
1000	Y			Y		NAT. GAS	3/19/1996	7.7	2116	202	67.1		
1000	Y			Y		NAT. GAS	3/4/1997	8.2	2182	202	28.5	83	
1000	Y			Y		NAT. GAS	3/26/1996	7.7	1413	136.4	53.4		
1000	Y			Y		NAT. GAS	3/6/1997	8.5	1644	149	58	110	
1000	Y			Y		NAT. GAS	3/28/1996	7.8	2101	202.5	53		
1000	Y			Y		NAT. GAS	3/11/1997	8.1	2111	199	57	107	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	CONTROLS PSC	CONTROLS PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
1000		Y		Y		NAT. GAS	4/2/1996	8.5	4200	192			
1000	Y			Y		NAT. GAS	3/11/1997	8.5	2115	195	64	125	
1000	Y			Y		NAT. GAS	4/9/1996	8.41	3754	176			
1000	Y			Y		NAT. GAS	3/13/1997	8.9	2290	203	78	124	
1000	Y			Y		NAT. GAS	6/13/1996	8	2102	198			
1000				Y		NAT. GAS	12/18/1997	8.8	2020	7.8	49.4	132	
1000	Y			Y		NAT. GAS	6/19/1996	8	1922	180	125		
1000	Y			Y		NAT. GAS	4/3/1997	8.75		211	27	75	
2000	Y				Y	NAT. GAS	6/4/1996	12	5021	316	182	294	564
2000	Y				Y	NAT. GAS	5/29/1997	12.1		298	43	233	40
2000	Y				Y	NAT. GAS	6/4/1996	11.9	4631	294	123	336	361
1000	Y			Y		NAT. GAS	6/3/1997	11.9	4791	333	64	227	93

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
2000	Y				Y	NAT. GAS	6/6/1996	12.2	5087	318	144	355	474
2000	Y			Y		NAT. GAS	7/23/1997	12	5540	358	63	258	
1000	Y			Y		NAT. GAS	4/25/1996	8.5	4468	199	150		
1000	Y			Y		NAT. GAS	4/10/1997	7.5		210	64	122	
1000	Y			Y		NAT. GAS	4/25/1996	7.7	2070	145	141		
1000	Y			Y		NAT. GAS	6/3/1997	8	2066	195	70	58	
1000	Y				Y	NAT. GAS	4/24/1996	10.3	2285	176	62	658	561
1000	Y				Y	NAT. GAS	4/8/1997	9.6		148	69	302	310
1000	Y				Y	NAT. GAS	4/23/1996	11.3	5044	176	22	571	699
1000	Y				Y	NAT. GAS	4/8/1997	10.8		163	51	284	382
1500	Y				Y	NAT. GAS	6/11/1996	10	2255	179			
1500	Y				Y	NAT. GAS	6/10/1997	9.7	1900	155	48	259	

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS CAT	PSC	PCC	FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
1500	Y				Y	NAT. GAS	6/6/1996	9.8	2418	194	105	551	594
1500	Y				Y	NAT. GAS	4/10/199 7	9.8		163	41	12	264
490		Y	Y			NAT. GAS	4/30/199 6	0	1398	108	90		
490		Y	Y			NAT. GAS	4/15/199 7	0.01	557	86	65	35	
490		Y	Y			NAT. GAS	4/16/199 7	0.01		106	11.5	288	
490		Y	Y			NAT. GAS	4/30/199 6	0.01	1079	109	21		
490		Y	Y			NAT. GAS	4/15/199 7	0.02	350	55	17.1	113	
490		Y	Y			NAT. GAS	5/14/199 6	0.11	438	67	24.3		
490		Y	Y			NAT. GAS	4/22/199 7	0.01	455	70	44.4	997	
325	Y					NAT. GAS	10/8/199 6	7.6			61.2	205	
255		Y	Y			NAT. GAS	10/2/199 6	0.12			7.6	483	
269	Y					NAT. GAS	6/14/199 6	13.3	761	43.6			

San Joaquin Valley Unified APCD IC Engine Source Test Data

HP	LEAN	RICH	CONTROLS			FUEL TYPE	TEST DATE	O2%	STACK FLOW CFM	FUEL RATE ft^3/day X 10^3	NOX PPM 15% O2, TESTED	CO PPM 15% O2, TESTED	VOC PPM 15% O2, TESTED
			CAT	PSC	PCC								
269	Y					NAT. GAS	7/11/1996	14.5	988	54			
115	Y					NAT. GAS	11/18/1996						
145		Y	Y			NAT. GAS	6/17/1996	0.1	125		61	1215	

APPENDIX E

ENGINE POWER TEST CODE
SAE J 1349

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space® INTERNATIONAL

400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

Submitted for recognition as an American National Standard

SAE J1349 REAF. JUN95

Issued 1980-12
Reaffirmed 1995-06

Superseding J1349 JUN90

ENGINE POWER TEST CODE—SPARK IGNITION AND COMPRESSION IGNITION—NET POWER RATING

TABLE OF CONTENTS

1. Scope—This SAE Standard has been adopted by SAE to specify:

a. A basis for net engine power rating
b. Reference inlet air and fuel supply test conditions
c. A method for correcting observed power to reference conditions
d. A method for determining net full load engine power with a dynamometer

1.1 Field of Application—This test code document is applicable to both four-stroke and two-stroke spark ignition (SI) and compression ignition (CI) engines, naturally aspirated and pressure charged, with and without charge air cooling. This document does not apply to aircraft or marine engines.

1.2 This test code supersedes those portions of SAE J1349 JUN90 dealing with net power rating.

1.3 Standard CI diesel fuel specifications are range mean values for Type 2-D EPA test fuel per Title, 40, Code of Federal Regulations, Part 86.1313-87.

1.4 The corresponding test code for gross power rating is SAE J1995.

1.5 The document for mapping engine performance is SAE J1312.

1.6 Relationship to ISO 1585—ISO 1585 (DIS in 1989) differs from SAE J1349 in several areas, among which the most important are:

a. This document is not limited to road vehicles.
b. This document requires inlet fuel temperature be controlled to 40 °C on CI engines.
c. This document includes a reference fuel specification and requires that engine power be corrected to that specification on all CI and certain SI engines.
d. This document includes a different procedure for testing engines with a laboratory charge air cooler (ISO method optional).
e. This document stipulates a 20% duty cycle limit on variable speed cooling fans in order to qualify for testing at the minimum power loss settings.

1.7 Complete correlation has not been established with ISO 3046, ISO 2288, ISO 9249, or with ISO 4106. It is expected that these power test codes will eventually align with ISO 1585.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1312—Procedure for Mapping Engine Performance—Spark Ignition and Compression Ignition Engines
SAE J1995—Engine Power Test Code—Spark Ignition and Compression Ignition—Gross Power Rating

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 1585—Road vehicles—Engine test code—Net power
ISO 2288—Agricultural tractors and machines—Engine test code (bench test)—Net power
ISO 3046—Reciprocating internal combustion engines—Performance
ISO 4106—Motorcycles—Engine test code—Net power
ISO 9249—Earth-moving machinery—Engine test code—Net power

2.1.3 FEDERAL REGULATION—Available from The Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

CFR 40 Part 86.1313-87

3. Terms and Definitions—This section contains the definitions of key terms used to describe the net power test.

3.1 Net Brake Power—The power of an engine when configured as a "fully equipped" engine as defined in 3.4 and 6.2, and tested and corrected in accordance with this document.

3.2 Rated Net Power—Engine net power as declared by the manufacturer at "rated speed."

3.3 Rated Speed—The speed determined by the manufacturer at which the engine power is rated.

3.4 **Fully Equipped Engine**—A "fully equipped" engine is an engine equipped with only those accessories necessary to perform its intended service. A fully equipped engine does not include components that are used to power auxiliary systems. If these components are integral with the engine or for any reason are included on the test engine, the power absorbed may be determined and added to the net brake power. Common "fully equipped" engine accessory examples are listed in Table 1.

TABLE 1—ENGINE EQUIPMENT

System	Required	Comments
1. Inlet Air System	Yes	See 6.1.1.
Air Ducting	Yes	
Air Cleaner	Yes	
Air Preheat	No	
2. Pressure Charging System	Yes	For all engines equipped with variable boost as a function of other engine parameters (speed/load/ fuel octane, etc.), the boost pressure controls must be set to reflect intended in-service operation.
Boost Control Settings	Manufacturer's Specification	
3. Charge Air Cooling System	Yes	If applicable.
Charge Air Cooler	Yes	See 6.1.4 for auxiliary cooler options.
Cooling Pump or Fan	Conditional	Not required if it can be shown to be functioning less than 20% of running time during intended in-service operation at reference test conditions.
4. Electrical System	Yes	See 6.1.5.
Ignition System	Yes	
Starter	No	
Generator/Alternator	Conditional	Required only if needed to operate the fully equipped engine in a self-sustained manner and an external power supply is not used. In this case, the generator shall operate at a load level only sufficient to power the required components (i.e., fuel injectors, electric fuel pump).
Ignition and Timing Control Settings	Manufacturer's Specification	For any engine equipped with electronic controls and/or knock sensors, the spark or timing advance must be adjusted to reflect intended in-service operation.
5. Emissions Control System	Yes	All control settings or adjustments must be set to reflect intended in-service operation.
6. RFI/EMI Controls (radio frequency or electromagnetic interference)	Manufacturer's Specification	Control settings must reflect intended in-service operation.
7. Fuel Supply System	Yes	
Fuel Filters/Prefilters	Optional	See 6.1.3.
Fuel Supply Pump	Yes	Or equivalent electrical load if applicable.
Injection Pump/Carburetor or Fuel Metering Control Settings	Manufacturer's Specification	Control settings must reflect intended in-service operation.

TABLE 1—ENGINE EQUIPMENT (CONTINUED)

System	Required	Comments
8. Engine Cooling System (liquid)	Yes	
Cooling Pump	Yes	
Radiator	Optional	Functionally equivalent laboratory system recommended.
Thermostat	Optional	If not used, then coolant temperature and flow shall be regulated to intended in-service levels.
Cooling Fan	Yes	On variable speed units the fan may be run at minimum power consumption levels if it can be shown to be functioning less than 20% of engine running time during intended in-service operation at reference test conditions. NOTE—If for any reason the fan is omitted, the minimum allowable fan power should be determined and subtracted from the net brake power. If run at full output, the fan power absorbed should be calculated and the difference between it and the minimum allowable fan power shall be added to the net brake power.
Engine Cooling System (Air)	Yes	
Blower	Yes	See previous comments—same as liquid cooling fan.
9. Lubrication System	Yes	The fully equipped engine closed loop lubrication system is used. Oil fill shall be at manufacturer's full level. Oil temperatures shall reflect in-service levels at reference test conditions.
10. Exhaust System	Yes	See 6.1.2.
11. Auxiliary Drives		
Power Steering Pump	No	
Freon Compressor	No	
Vacuum Pumps	Conditional	Required only if needed to drive other required systems listed, and it functions in that capacity more than 20% of engine running time during intended in-service operation.
Air Compressors	Conditional	See previous comments—same as vacuum pumps.

3.5 Reference Test Conditions—The standard or reference engine inlet air supply (atmospheric) and inlet fuel conditions to which all power corrections are made.

3.6 Friction Power—The power required to drive the engine alone as equipped for the power test. Friction power may be established by one of the following methods (the value is needed for power correction of spark ignition engines):

a. Assume 85% mechanical efficiency.
b. Hot Motoring Friction—Record friction torque at wide open throttle at each test speed run on the power test. All readings are to be taken at the same coolant and oil temperature as observed on the power test points ±3 °C.

3.7 Indicated Power—The power developed in the cylinders. It is defined as the sum of the brake power and friction power for the purpose of this document.

4. Symbols, Units, and Subscripts

4.1 Symbols and Units—See Table 2.

TABLE 2—SYMBOLS AND UNITS

Symbols	Term	Units
CA	Air correction factor	
CF	Fuel correction factor	
fa	Atmospheric factor	
fm	Engine factor	
fd	Fuel density factor	
fv	Fuel viscosity factor	
α	Pressure sensitivity exponent	
β	Temperature sensitivity exponent	
S	Viscosity sensitivity coefficient	
D	Engine displacement	l
B	Inlet air supply total pressure	kPa
t	Inlet air supply temperature	°C
P	Inlet manifold total pressure	kPa
r	Pressure ratio	
q	Fuel delivery	mg/L cycle
bp	Brake power	kW
fp	Friction power	kW
ip	Indicated power	kW
n	Engine speed	min^{-1}
F	Fuel flow	g/s
SG	Fuel density at 15 °C	kg/L
V	Fuel viscosity at 40 °C	mm^2/s

4.2 Subscripts

c = Refers to data corrected to reference inlet air and fuel supply conditions
o = Refers to data observed at the actual test conditions
d = Refers to the dry air portion of the total inlet air supply pressure
r = Refers to the reference test conditions per Section 5

5. Reference Test Conditions and Corrections—This section contains reference air and fuel supply test conditions and specifications, recommended test ranges, and applicability of the correction procedures.

5.1 Reference Atmospheric Conditions—Table 3 is reference atmospheric conditions and test ranges for which the correction procedures are valid.

TABLE 3—REFERENCE ATMOSPHERIC CONDITIONS

	Standard Condition	Recommended Test Range Limits
Inlet Air Supply Pressure (absolute)	100 kPa	—
Dry Air Pressure (absolute)	99 kPa	90-105 kPa
Inlet Air Supply Temperature	25 °C	15-40 °C

5.2 **Reference SI Gasoline Specifications**—Reference gasoline research and motor octane numbers in Table 4 have been determined corresponding to "regular" and "premium" test fuels. Reference gasoline is required for all SI engines equipped with knock sensors or other devices that control spark advance as a function of spark knock. Other SI engines may use any gasoline with an octane number sufficient to prevent knock.

TABLE 4—REFERENCE SI GASOLINE SPECIFICATIONS

	Regular Fuel	Premium Fuel
Research Octane No.:	92 ± 0.5	97 ± 0.5
Motor Octane No.:	83 ± 0.5	87 ± 0.5
Lower Heating Value:	43.3 MJ/kg ± 0.1 MJ/kg	43.1 MJ/kg ± 0.1 MJ/kg

5.3 **Reference CI Fuel Specifications**—Reference fuel specifications are per Title 40, Code of Federal Regulations, Part 86.1313-87, and represent range mean values for Type 2-D diesel fuel. The reference fuel characteristics in Table 5 have been determined to affect engine test power, and are listed with the applicable test ranges for which the correction procedures are valid.

TABLE 5—REFERENCE CI FUEL SPECIFICATIONS

	Standard Condition	Test Range Limits
Fuel Density at 15 °C	0.850 kg/L	0.840-0.860 kg/L
Fuel Kinematic Viscosity at 40 °C	2.6 mm²/s	2.0-3.2 mm²/s
Fuel Inlet Temperature	40 °C	39-41 °C (pump/line/nozzles) or 37-43 °C (unit injectors)

Observed engine power is also corrected for variations in lower heating value (LHV) based on an empirical relationship between LHV and fuel density per 9.4.2.

5.4 **Alternate Fuels**—Reference values for alternate SI and CI fuels, both liquid and gaseous, are not presented in this document. Therefore, when alternate fuels are used for the net power engine test, no corrections to reference fuel conditions shall be made.

5.5 **Power Corrections**—The performance of SI and CI engines is affected by the density of the inlet combustion air as well as by the characteristics of the test fuel. Therefore, in order to provide a common basis of comparison, it may be necessary to apply correction factors to the observed net power to account for differences between reference air and fuel conditions and those at which the test data were acquired.

5.5.1 All power correction procedures for atmospheric air are based on the conditions of the engine inlet air supply immediately prior to the entrance into the engine inlet system. This may be ambient (atmospheric) air or a laboratory air plenum that maintains air supply conditions within the range limits defined per 5.1.

5.5.2 On any engine where the power output is automatically controlled to compensate for changes in one or more of the listed inlet air and fuel supply test conditions, no correction for that test parameter shall be made.

5.5.3 The magnitude of the power correction should not exceed 5% for inlet air or 3% for inlet fuel corrections. If the correction factor exceeds these values, it shall be noted in accordance with 8.1.

5.6 Correction Formulas—The applicable correction formulas for spark ignition and compression ignition engines are listed in Section 9. These correction formulas are designed for correction of net brake power at full throttle operation; however, for CI engines the formulas may also be used to correct partial load power for the purpose of determining specific fuel consumption. These correction formulas are not intended for altitude derating.

6. Laboratory and Engine Equipment—This section contains a list of laboratory and engine equipment used in the net power test.

6.1 Laboratory Equipment—The following standard laboratory test equipment is required for the net power test.

6.1.1 INLET SYSTEM—The intended service inlet system or any laboratory system that provides equivalent restriction at all speeds and loads. The inlet system begins at the point where air enters from the supply source (atmosphere or lab plenum) and ends at the entrance to the throttle body, inlet manifold, or turbocharger inlet, on engines as appropriate.

6.1.2 EXHAUST SYSTEM—A complete intended service exhaust system (including mufflers, catalytic converters, resonators, etc.) or any laboratory system that provides equivalent restriction at all speeds and loads. The exhaust system begins at the exhaust manifold outlet or at the turbine outlet on engines so equipped.

6.1.3 FUEL SUPPLY SYSTEM—Any laboratory system that provides a supply of fuel to the fuel inlet of the fully equipped engine. The fuel supply system must be capable of controlling fuel supply temperature to within the ranges specified in 5.3 for CI engines. The fuel supply system shall not exceed the manufacturer's maximum permissible restriction requirements, if applicable.

6.1.4 CHARGE AIR COOLER—For charge-cooled engines a laboratory auxiliary cooler may be employed for test purposes. If used, one of the following test methods is required and the appropriate correction procedure is applied per Section 9:

a. Standard Method—This is the preferred test method. The laboratory unit is set to simulate intended in-service charge air cooler restriction and inlet manifold temperatures as if the ambient and inlet supply air temperatures were 25 °C.
b. Optional Method—The laboratory unit is set to duplicate the charge air cooler restriction and inlet manifold temperatures that would be obtained during intended service operation at the observed inlet air test conditions.

6.1.5 AUXILIARY POWER SUPPLY—Electrically driven engine components determined to be part of the basic engine may be operated via an external power supply. In such cases, the power required must be determined and subtracted from the corrected net brake power.

6.2 Engine Equipment—A fully equipped engine, as defined in 3.4, is used for the net power test. Table 1 lists fully equipped engine accessories and control settings required for the net power test.

*7. **Test Procedures***—This section contains the required test procedures for determining net engine power.

7.1 Instrumentation Accuracy—The following minimum test instrumentation accuracy is required:

a. Torque—±0.5% of measured value
b. Speed—±0.2% of measured value
c. Fuel Flow—±1% of measured value
d. Temperature—±2 °C
e. Air Supply, Inlet and Exhaust Pressures—±0.1 kPa
f. Other Gas Pressures—±0.5 kPa

7.2 Adjustments and Run-in

7.2.1 Adjustments shall be made before the test in accordance with the manufacturer's instructions. No changes or adjustments shall be made during the test.

7.2.2 The engine shall be run-in according to the manufacturer's recommendation. If no such recommendation is available, the engine shall be run-in until corrected brake power is repeatable within 1% over an 8 h period.

7.3 Pressure and Temperature Measurement

7.3.1 Pressure and temperature of the inlet air supply, used for the purpose of engine power corrections, shall be measured in a manner to obtain the total (stagnation) condition at the entrance to the engine inlet system. On those tests where the engine air supply is ambient air, this pressure is the barometric pressure; on those tests where the air supply is test cell ambient air, this pressure is the cell barometric pressure.

7.3.2 Inlet air pressure, used for the purpose of determining inlet system restriction, shall be measured in a manner to obtain the total (stagnation) pressure immediately prior to the end of the inlet system as defined in 6.1.1.

7.3.3 Inlet manifold pressure and temperature shall be measured as static values with probes located in a section common to several cylinders. In such installations dynamic pressure is assumed zero.

7.3.4 On charge air-cooled engines in which a laboratory cooler is employed for testing, precooler charge air pressure must also be measured for the purpose of setting in-service restrictions per 6.1.4. Precooler pressure must be measured upstream of the auxiliary unit in a manner to obtain the total (stagnation) value. Auxiliary cooler restriction is the difference between the precooler and inlet manifold pressures.

7.3.5 Coolant temperatures in liquid-cooled engines shall be measured at the inlet and outlet of the engine, in air-cooled engines at points specified by the manufacturer.

7.3.6 Oil pressure and temperature shall be measured at the entrance to the main oil gallery.

7.3.7 Fuel temperature shall be measured at the inlet to the carburetor or fuel injector rail for SI engines, and at the inlet to the high-pressure injection pump or unit injector rail for CI engines, and at the outlet of the volumetric flow meter for gaseous fueled engines.

7.3.8 Exhaust pressure shall be measured in a manner to obtain the total (stagnation) pressure in a straight section of piping not less than three nor more than six diameters downstream of the entrance to the exhaust system as defined in 6.1.2.

7.4 Test Operating Conditions

7.4.1 The engine must be started and warmed up in accordance with manufacturer's specifications. No data shall be taken until torque and speed have been maintained within 1% and temperatures have been maintained within ±2 °C for at least 1 min.

7.4.2 Engine speed shall not deviate from the nominal speed by more than ±1% or ±10 min^{-1}, whichever is greater.

7.4.3 Coolant outlet temperature for a liquid-cooled engine shall be controlled to within ±3 °C of the nominal thermostat value specified by the manufacturer. Coolant inlet air temperature for an air-cooled engine is regulated to 35 °C ± 5 °C.

7.4.4 Fuel inlet temperature for diesel fuel injection shall be controlled to 40 °C ± 3 °C for unit injector systems, and 40 °C ± 1 °C for pump/line/nozzle systems. Test fuel temperature control is not required on SI engine power tests.

7.4.5 The exhaust gas must be vented to a reservoir having a total pressure within 0.75 kPa of the inlet air supply pressure.

7.5 Test Points—Record full throttle data for at least five approximately evenly spaced operating points to define the power curve between 600 rpm (or the lowest stable speed) and the maximum engine speed recommended by the manufacturer. One of the operating speeds shall be the rated speed, one shall be the peak torque speed.

8. Presentation of Results—This section contains a listing of test data to be recorded and procedures for presenting results.

8.1 Reporting Requirements—All reported engine test data shall carry the notation: "Performance obtained and corrected in accordance with SAE J1349." Any deviation from this document, its procedures, or limits shall be noted. All reported or advertised test data bearing the SAE J1349 notation shall include a minimum of the following information at each test point:

a. Engine speed
b. Corrected net brake power (or torque)

8.2 Recorded Test Conditions—Record the following ambient air, fuel, and lubricating oil test conditions and specifications.

8.2.1 INLET AIR SUPPLY CONDITIONS

a. Air supply pressure
b. Air supply vapor pressure
c. Air supply temperature

8.2.2 SPARK IGNITION ENGINE FUEL-LIQUID

a. Fuel type and/or blend
b. Research and motor octane numbers
c. Lower heating value

8.2.3 SPARK IGNITION ENGINE FUEL-GASEOUS

a. Fuel type or grade
b. Composition
c. Density at 15 °C and 101 kPa
d. Lower heating value

8.2.4 DIESEL FUELS

a. ASTM or other fuel grade
b. Density at 15 °C
c. Viscosity at 40 °C
d. Lower heating value (optional)

8.2.5 LUBRICATING OIL

a. API engine service classification
b. SAE-viscosity grade
c. Manufacturer and brand name

8.3 Recorded Test Data—Record the following minimum information at each data test point:

a. Brake torque
b. Friction torque (if measured)
c. Engine speed
d. Fuel flow rate
e. Fuel supply pressure and temperature
f. Ignition and/or injection timing
g. Oil pressure and temperature
h. Coolant temperature
i. Inlet manifold air temperature and pressure
j. Total pressure drop across the inlet air system
k. Total pressure drop across the auxiliary cooler (if applicable)
l. Total pressure drop across the exhaust system
m. Smoke (optional—CI engines only)

8.4 Engine Equipment—Record all engine equipment listed per 6.2. Additionally, record engine manufacturer, displacement, bore and stroke, number and configuration of cylinders, carburetion or injection system type, plus type of pressure-charging system, if applicable. If a laboratory charge air cooler is used, record the test method per 6.1.4.

For SI engines equipped with knock sensors, the engine should be designated as a "regular" or "premium" fuel engine. For those SI engines without knock sensors, the minimum octane number for which knock does not occur shall be recorded as stated by the engine manufacturer.

8.5 Additional Recorded Information—Record any other pertinent test data as determined by the manufacturer. This may include, but is not limited to: test date, engine serial number, test number, test location, etc.

9. ***Correction Formulas***—This section includes all formulas necessary to correct observed engine power performance for deviations in inlet air and fuel supply conditions.

9.1 Spark Ignition Correction Formulas—These spark ignition engine correction formulas are only applicable at full (WOT) throttle positions.

$$bp_c = CA \times bp_o \quad \text{(Eq.1)}$$

Calculation of atmospheric correction factor, CA. If 85% mechanical efficiency is assumed:

$$CA = 1.18\left[\left(\frac{99}{B_{do}}\right)\left(\frac{t_o + 273}{298}\right)^{0.5}\right] - 0.18 \quad \text{(Eq.2)}$$

If friction power is measured:

$$bp_c = ip_c - fp_o \quad \text{(Eq.3)}$$

where:

$$ip_c = ip_o\left(\frac{99}{B_{do}}\right)\left(\frac{t + 273}{298}\right)^{0.5} \quad \text{(Eq.4)}$$

and:

$$ip_o = fp_o + bp_o \quad \text{(Eq.5)}$$

NOTE—If a lab auxiliary charge air cooler is used in conjunction with the standard test method per 6.1.4, no inlet air temperature corrections shall be made. In this case, the temperature correction exponent becomes zero. Otherwise use the previous equation.

9.2 Compression Ignition Engine Correction Formulas—These CI engine correction formulas are applicable at all speed and load levels.

$$bp_c = (CA \times CF)\, bp_o \quad \text{(Eq.6)}$$

9.2.1 CALCULATION OF ATMOSPHERIC CORRECTION FACTOR, CA

$$CA = (fa)^{fm} \quad \text{(Eq.7)}$$

where:

$$fa = \left(\frac{B_{dr}}{B_{do}}\right)^{\alpha}\left(\frac{t_o + 273}{t_r + 273}\right)^{\beta} = \left(\frac{99}{B_{do}}\right)^{\alpha}\left(\frac{t_o + 273}{298}\right)^{\beta} \quad \text{(Eq.8)}$$

and values for α and β, are summarized in Table 6:

TABLE 6—ATMOSPHERIC CORRECTION FACTOR EXPONENTS

Pressure Charging System	Charge Air Cooling System	α	β
Naturally Aspirated	None	1.0	0.7
Mechanically Supercharged	All	1.0	0.7
Turbocharged	None	0.7	1.2
Turbocharged	Air-to-Air	0.7	1.2
Turbocharged	Jacket Water	0.7	0.7
Turbocharged	Lab Auxiliary (Standard)	0.7	0.4
Turbocharged	Lab Auxiliary (Optional)	0.7	1.2

Where "standard" and "optional" refer to the lab auxiliary cooler test method described in 6.1.4.

The value of fm is given as:

q/r	fm	
Less than 37.2	0.2	
Between 37.2 and 65	(0.036 x q/r) – 1.14	(Eq.9)
More than 65	1.2	

where:

q = 120 000 F/Dn for four-stroke engines
q = 60 000 F/Dn for two-stroke engines
r = P_o/B_o for all engines (r = 1 if naturally aspirated)

9.2.2 CALCULATION OF FUEL CORRECTION FACTOR, CF

$$CF = fd \times fv \qquad \text{(Eq.10)}$$

where:

$$fd = 1 + 0.70\left(\frac{SG_r - SG_o}{SG_o}\right) = 1 + 0.70\left(\frac{0.850 - SG_o}{SG_o}\right) \qquad \text{(Eq.11)}$$

and:

$$fv = \frac{1 + S/V_o}{1 + S/V_r} = \frac{1 + S/V_o}{1 + S/2.6} \qquad \text{(Eq.12)}$$

NOTE—The previous equations correct observed power to reference fuel density and viscosity levels. A correction coefficient of 0.70 in the previous density factor equation is added to account for typical changes in lower heating value at differing density levels, based on an empirical LHV-SG relationship.

Values of S shall be determined by the engine manufacturer. If no values are available, the following shall be used:

a. Pump/Line/Nozzle Systems—0.15
b. Unit Injectors—0.0

NOTE—If used for the purpose of determining specific fuel consumption, the corrected fuel flow is given by the following:

$$F_c = (SG_r/SG_o \times fv)\ F_o \quad \text{(Eq.13)}$$

PREPARED BY THE SAE POWER TEST CODE COMMITTEE

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This SAE Standard has been adopted by SAE to specify:

a. A basis for net engine power rating.
b. Reference inlet air and fuel supply test conditions.
c. A method for correcting observed power to reference conditions.
d. A method for determining net full load engine power with a dynamometer.

Reference Section

SAE J1312—Procedure for Mapping Engine Performance—Spark Ignition and Compression Ignition Engines

SAE J1995—Engine Power Test Code—Spark Ignition and Compression Ignition—Gross Power Rating

ISO 1585—Road vehicles—Engine test code—Net power

ISO 2288—Agricultural tractors and machines—Engine test code (bench test)—Net power

ISO 3046—Reciprocating internal combustion engines—Performance

ISO 4106—Motorcycles—Engine test code—Net power

ISO 9249—Earth-moving machinery—Engine test code—Net power

CFR 40 Part 86.1313-87

Developed by the SAE Power Test Code Committee

APPENDIX F

LEGAL OPINION REGARDING THE REGULATION OF STATIONARY SOURCES USED IN AGRICULTURAL OPERATIONS

Winston H. Hickox
Secretary for Environmental Protection

Air Resources Board

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Gray Davis
Governor

MEMORANDUM

TO: Peter D. Venturini, Chief
Stationary Source Division

THROUGH: Kathleen Walsh
Chief Counsel

FROM: Judith G. Tracy
Staff Counsel

DATE: August 18, 1999

SUBJECT: REQUEST FOR LEGAL OPINION REGARDING THE REGULATION OF STATIONARY SOURCES USED IN AGRICULTURAL OPERATIONS

In connection with the Air Resources Board's (ARB's) development of a Proposed Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology (RACT/BARCT) for Stationary Internal Combustion (IC) Engines, you requested a legal opinion that clarifies the authority of air districts to include emission limits for stationary IC engines if they are used in agricultural operations, given their exemption from district permitting requirements. Specifically, the questions you asked are:

(1) what is a district's authority to adopt prohibitory rules, recover costs, and take enforcement actions for stationary sources used in agricultural operations?

(2) could a district impose registration requirements and registration fees for these sources?

(3) what types of enforcement options would be available to a district if a source is out of compliance; for example, could a district impose fines, issue variances, or issue abatement orders?

BRIEF ANSWER

Air districts are responsible for control of air pollution from all sources other than vehicular sources. Stationary sources located in a nonattainment district may be controlled so as to reduce pollutant emissions and thereby meet the statutory goal of achieving and maintaining the state air quality standards at the earliest practicable date. This authority of districts to control emissions applies to all stationary sources, even if the sources are used in agricultural operations. Therefore, we conclude that districts, in order to carry out their statutory mandate to achieve and maintain the air quality standards, may adopt prohibitory rules, recover costs, and take enforcement actions for stationary IC engines used in agricultural operations. Districts may impose registration requirements and registration fees for these sources through district regulations. Moreover, districts may impose fines, issue variances, and issue abatement orders if such sources are out of compliance. However, districts must take these actions outside of the district permit system because stationary IC engines used in agricultural operations are statutorily exempt from district permitting requirements.

BACKGROUND

District Responsibilities to Protect Air Quality. The California Legislature through Part 1 of Division 26 of the Health & Safety Code[1] imposes broad responsibility on ARB and the local air districts for protection and enhancement of the ambient air quality of the state. While control of vehicular sources is the responsibility of the Air Resources Board,[2] "[l]ocal and regional authorities have the primary responsibility for control of air pollution from *all sources other than vehicular sources*."[3] Nonvehicular sources are defined as *"all sources of air contaminants*, including the loading of fuels into vehicles, except vehicular sources."[4] "Air contaminants" means "any discharge, release, or other propagation into the atmosphere and includes, but is not limited to, smoke, charred paper, dust, soot, grime, carbon, fumes, gases, odors, particulate matter, acids, or any combination thereof."[5] To aid local and regional authorities in accomplishing the task of controlling air pollution from nonvehicular sources, the Legislature authorizes them to establish even stricter standards than those set by law or by the Air Resources Board for those sources.[6]

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[1] All references to sections are to the Health & Safety Code unless otherwise specified.

[2] Section 39002.

[3] Section 39002, emphasis added.

[4] Section 39043. "Vehicular sources" are "those sources of air contaminants emitted from motor vehicles." Section 39060.

[5] Section 39013.

[6] Section 39002.

The Legislature reiterates this broad charge for local and regional authorities in Part 3 of Division 26, governing air pollution control districts. Under Part 3, local and regional authorities (districts) [7] have primary responsibility for control of air pollution from *all sources other than emissions from motor vehicles*.[8] The districts are required to adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by *emission sources under their jurisdiction*.[9] In addition, Part 4 prohibits discharge *from any source whatsoever*, such quantities of air contaminants which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public.[10] Part 4 also authorizes districts, except as otherwise specifically provided in Division 26, to "establish additional, stricter standards than those set forth by law or by [ARB] for nonvehicular sources."[11]

District Attainment Plans. Part 3 also requires districts that are designated nonattainment for state ambient air quality standards for ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide to prepare and submit to ARB plans for attaining and maintaining the standards.[12] The plans must achieve and maintain the state standards by the earliest practicable date, considering all relevant factors, such as pollutant concentrations, distribution and frequency of violations, transport contributions, projected increases, emission inventory characteristics, effectiveness of control measures, emission reductions, and military base reuses.[13] District boards must determine that the plan is a cost-effective strategy to achieve attainment of the state standards by the earliest practicable date.[14] District plans must achieve districtwide emissions reductions of at least 5 percent per year or alternatively, demonstrate that all feasible measures have been included in the plan and the alternative strategy is at least as effective as the district plan.[15]

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[7] "District" means an air pollution control district or an air quality management district created or continued in existence pursuant to provisions of Part 3. Section 39025.

[8] Section 40000, emphasis added. The Air Resources Board has responsibility for control of motor vehicle emissions, except as otherwise provided in Division 26. *Id.*

[9] Section 40001(a), emphasis added. District adoption of such rules are subject to certain requirements, e.g. determination that the rule will alleviate a problem and will promote attainment or maintenance of state or federal ambient air quality standards.

[10] Section 41700, emphasis added. Discharge of contaminants that endanger the comfort, repose, health, or safety of any considerable number of persons or the public, or that cause, or have a natural tendency to cause, injury or damage to business or property are also prohibited. *Id.*

[11] Section 41508.

[12] Section 40911. Control strategies for nitrogen oxides and volatile organic gases, which are ozone precursors, are included in district attainment plans.

[13] Section 40913(a).

[14] Section 40913(b).

[15] Section 40914.

District Requirements for RACT and BARCT. Districts are classified according to their air pollution status as moderate, serious, severe, or extreme,[16] and are subject to various requirements depending on that classification.[17] Plans for districts that are classified moderate and above must include measures for reasonably available control technology (RACT) for *all existing stationary sources*, except that stationary sources permitted to emit five tons or more per day or 250 tons or more per year must be equipped with the best available retrofit control technology (BARCT).[18] RACT is generally considered to be "those emission limits in regulations that would result in the application of demonstrated technology to reduce emissions."[19] BARCT is defined as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source."[20] In particular applications RACT and BARCT may be the same, but RACT will never be more stringent than BARCT.[21] In addition to the measures required for districts classified as moderate, districts classified as serious or above must include measures for BARCT, as defined in section 40406, for *all existing permitted stationary sources.*[22] The district plans must include these specified measures to the extent necessary to meet plan requirements under section 40913, that is, plans must be designed to achieve and maintain the state standards by the earliest practicable date.[23] ARB is responsible for ensuring that districts' attainment plans meet statutory requirements and that every reasonable action is taken to achieve the state standards for ozone, carbon monoxide, nitrogen dioxide, and sulfur dioxide at the earliest practicable date. [24]

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[16] Section 40921.

[17] Sections 40918, 40919, 40920, 40920.5.

[18] Sections 40918(a)(2), 40919, 40920, 40920.5, emphasis added. New or modified stationary sources with the potential to emit 25 pounds per day or more of any nonattainment pollutant or precursor must use best available control technology (BACT). *Id.*

[19] Air Resources Board, Stationary Source Division, California Clean Air Act Guidance, Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology, p.3, March 1990. RACT is not further defined. In Division 26, the term RACT appears only in sections 40728.5(d) (federal RACT), 40918, and 42301.2 (offset requirements).

[20] Section 40406. This definition applies to the South Coast Air Quality Management District, the Sacramento Metropolitan Air Quality Management District through section 40952, and all districts classified serious and above through section 40919.

[21] Air Resources Board, Stationary Source Division, California Clean Air Act Guidance, Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology, p.3, March 1990.

[22] Section 40919(a)(3).

[23] Sections 40918(a), 40913.

[24] Section 41503.5.

Prior to adopting rules or regulations to meet requirements for BARCT, the district must meet certain requirements.[25] For example, districts must identify potential control options, assess their cost-effectiveness in dollars per ton of emission reduction potential, and calculate their incremental cost-effectiveness.[26] In addition, districts must review in a public meeting the effectiveness of the proposed control option and the cost-effectiveness and incremental cost-effectiveness of potential control options.[27] Finally, districts must make findings at the public hearing at which the regulation is adopted stating the reasons for the district's adoption of the control option.[28]

Districts are authorized to establish their own BARCT requirement based on consideration of the factors specified in section 40920.6(a) (cost-effectiveness of potential control options) and section 40406 (maximum degree of reduction achievable considering environmental, energy, and economic impacts) if the requirement complies with section 40001(d) (allowing alternative methods that provide equivalent performance) and is consistent with Chapter 10 (District Plans to Attain State Ambient Air Quality Standards), other state law, and federal law, including but not limited to, the applicable State Implementation Plan.[29] Districts are required to allow the retirement of marketable emission reduction credits under a program that complies with specified requirements in lieu of any requirement for BARCT, if the credit also complies with all district rules and regulations affecting those credits.[30]

District Permit Systems. Part 4, Nonvehicular Air Pollution Control, authorizes districts to establish permit systems that require prior permission to operate equipment that may cause issuance of air contaminants,[31] as well as permit conditions adequate to ensure compliance with applicable district rules and regulations.[32] Part 4 also provides for, among other things, fee schedules,[33] variances,[34] fines,[35] and orders for abatement[36] for permit systems. Under Part 4

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[25] Section 40920.6.

[26] Section 40920.6(a)(1)-(3).

[27] Section 40920.6(a)(4).

[28] Section 40920.6(a)(5).

[29] Section 40920.6(b). The State Implementation Plan is a plan for implementation, maintenance, and enforcement of federal ambient air quality standards under section 110 of the Clean Air Act. 42 U.S.C. 7410. "Applicable implementation plan" is defined in section 302(q) of the Clean Air Act. 42 U.S.C. 7602(q).

[30] Section 40920.6(c).

[31] Section 42300.

[32] Section 42301.

[33] Sections 42311, 42311.2, 42311.5, 42313.

[34] Sections 42350(b).

[35] E.g., sections 42400-42402.5.

[36] Section 42450.

permitting provisions, districts are prohibited from requiring emission offsets for any emission increase at a source that results from implementation of a control device used to comply with requirements for RACT or BARCT, unless a modification results in an increase in capacity of the unit being controlled.[37] Relevant to the questions at hand, districts may not require permits for a number of types of sources including "any equipment used in agricultural operations in the growing of crops or the raising of fowl or animals [except for certain orchard and citrus grove heaters]."[38]

District Cost Recovery for Equipment Not Required to be Permitted. Districts have a number of options for cost recovery and enforcement for equipment outside of the district permit system. First, districts are required to adopt budgets including a schedule of fees to be imposed by the district to fund its programs.[39] Nothing prohibits including in the schedule of fees the costs of implementing and enforcing requirements for sources not required to be permitted.[40] Second, district boards may adopt fee schedules applicable to *emission sources not included within a permit system* to cover the estimated reasonable costs of evaluating plans required by law or district rule or regulation, including, but not limited to, related review, inspection, and monitoring.[41] The fees shall not exceed the estimated costs of reviewing, monitoring, and enforcing the plan for which the fees are charged.[42] The district board is required to hold a public hearing at least 30 days prior to adoption of the fee schedule and must make available the actual or estimated costs required to provide the service for which the fee is proposed to be charged.[43] Districts are also authorized to adopt by regulation a schedule of fees to cover the costs of planning, evaluation, sampling and analysis, calculations and report preparation with respect to samples of emissions secured from air pollution emission sources.[44]

District Enforcement for Sources Not Required to be Permitted. Part 3 places squarely upon the district the responsibility for adopting *and enforcing* rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by emission sources under their jurisdiction.[45] This authority is not limited to sources that are permitted.[46]

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[37] Section 42301.2.

[38] Section 42310(e).

[39] Section 40131; section 40522 (South Coast AQMD).

[40] *Id.* The Health and Safety Code expressly authorizes South Coast AQMD to adopt a fee schedule for areawide and indirect emission sources for which permits are not issued. Section 40522.5.

[41] Section 41512.5, emphasis added.

[42] Section 41512.5.

[43] Section 41512.5.

[44] Section 41512.

[45] Section 40001, emphasis added.

[46] See *id.*

Districts are authorized to adopt rules and regulations to require the owner or operator of any air pollution emission source to take reasonable action to determine the amount of emissions from the source.[47] Districts are authorized to require the owner or operator of any air pollution emission source, except a noncommercial vehicular source, to provide a description of the source and data necessary to estimate the emissions of pollutants for which ambient air quality standards have been established, or their precursors, so that *the full spectrum of emission sources* can be addressed equitably pursuant to provisions regarding district attainment plans.[48] If a violation of a district rule, regulation, or order occurs, that violation may be enjoined in a civil action.[49] Districts may grant variances under certain conditions.[50] With specified exceptions, persons who violate Part 4, or any rule, regulation, or order of a district adopted pursuant to Part 1 to Part 4, are guilty of a misdemeanor and are subject to fines and imprisonment.[51] A person who negligently emits an air contaminant in violation of any provision of Part 4 or any rule, regulation, or order of ARB or a district pertaining to emission regulations or limitations is guilty of a misdemeanor and is subject to fines and imprisonment.[52] With specified exceptions, a person who violates Part 4 or any rule, regulation, or order of a district or ARB, issued pursuant to Part 1 to Part 4, is strictly liable for a civil penalty.[53] A person who negligently emits an air contaminant in violation of any provision of Part 4 or any rule, regulation, or order of ARB or a district pertaining to emission regulations or limitations is liable for a civil penalty.[54] Districts may, after notice and hearing, issue an order for abatement whenever the district finds that a person is in violation of any order, rule, or regulation prohibiting or limiting the discharge of air contaminants into the air.[55] Other provisions authorize districts to take enforcement actions against violators of district orders, rules, or regulations regardless of whether the source is a permitted source.[56]

Exemptions for Sources Used in Agricultural Operations. The Health and Safety Code expressly exempts certain sources from specific regulatory requirements, including certain sources used in agricultural operations. First, agricultural operations necessary for the growing of crops or raising of fowl or animals, and the use of other equipment in such operations, are explicitly excepted from the prohibitions against discharge of air contaminants that exceed

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[47] Section 41511.

[48] Section 40701(g), emphasis added.

[49] Section 41513.

[50] Sections 42350, 42352.

[51] Section 42400.

[52] Section 42400.1.

[53] Section 42402(a), (b).

[54] Section 42402.1.

[55] Section 42450.

[56] See, e.g., sections 42400.2, 42400.3, 42402.2, 42402.3, 42402.5.

statutory smoke and opacity limits.[57] Second, odors emanating from agricultural operations necessary for the growing of crops or the raising of fowl or animals are explicitly exempted from the prohibition against discharge of air contaminants that cause a nuisance or similar injury.[58] Finally, "any equipment used in agricultural operations in the growing of crops or the raising of fowl or animals," except for certain orchard and citrus grove heaters, are exempted from district permit requirements.[59] It is this final exemption from district permitting requirements that raises the questions addressed in this memorandum.

ANALYSIS

As discussed above, Division 26 of the Health and Safety Code provides authority for California's air districts to control emissions of air pollutants from nonvehicular sources. Stationary IC engines are nonvehicular sources that emit air pollutants, specifically nitrogen oxides, volatile organic gases, and carbon monoxide. Therefore, stationary IC engines are subject to district regulation to control emissions of air pollutants under Division 26. This memorandum examines whether stationary IC engines used in agricultural operations are included in the class of engines subject to district regulation.

First Question Presented: What is a district's authority to adopt prohibitory rules, recover costs, and take enforcement actions for stationary sources used in agricultural operations?

Issue: Stationary sources used in agricultural operations are expressly exempted from district permit requirements.[60] Does this exemption from permit requirements carry over to other district regulatory programs so that the district is not authorized to adopt prohibitory rules, recover costs, and take enforcement actions outside of a permit system for these sources?

Analysis: Part 1 of Division 26 of the Health and Safety Code, which assigns responsibility for control of air pollution, imposes broad responsibility on local air districts to control air pollution from all sources other than vehicular sources.[61] Imposition of this responsibility is repeated in

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[57] Section 41704(g).

[58] Section 41705.

[59] Section 42310. A number of other sections not relevant here provide for control of emissions from certain agricultural sources. See e.g., sections 41850-66 (agricultural burning), section 42314.5 (consideration of agricultural offset credits).

[60] Section 42310(e). This section reads "A permit shall not be required for . . . [a]ny equipment used in agricultural operations in the growing of crops or the raising of fowl or animals, except that the district board of any district which is, in whole or in part, south of the Sixth Standard Parallel South, Mount Diablo Base and Meridian, may require permits for the operation of orchard and citrus grove heaters. In no event shall a permit be denied an operator of such heaters if the heaters produce unconsumed solid carbonaceous matter at the rate of one gram per minute or less."

[61] Division 26, Part 1, General Provisions and Definitions.

the statutory provisions regarding specific responsibilities and authorities of the districts.[62] District authority to carry out the responsibility to control emissions from nonvehicular sources is then reinforced in other statutory provisions regarding nonvehicular sources.[63] Districts are not only authorized, but are required, to adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by emission sources under their jurisdiction.[64] Although the statutes place a number of conditions on the districts' implementation of these broad statutory directives,[65] none of the conditions for adopting rules and regulations exempts stationary sources used in agricultural operations from the districts' authority to control sources of air contaminants.[66] In fact, the statutory exemptions that do exist for stationary sources used in agricultural operations are extremely limited.[67] Courts have often stated that statutory exceptions are to be strictly construed.[68] In the only court opinion to examine the exception for agricultural operations in section 42310, the court characterized the statute as one that "provides a handful of fairly narrow exceptions to the permit system for enforcement of air pollution control standards in Health and Safety Code section 42300 et seq."[69] Although this case examined the applicability of the exception in section 42310 to certain types of agricultural equipment and not to the potential for such an exception to apply beyond the district permit system, it nevertheless provides insight to the scope of the exception, which the court considered to be narrow. Such a narrow exception does not begin to compare to the breadth of district responsibility for "control of air pollution from all sources other than vehicular sources."[70]

District authority to adopt rules and regulations includes authority to adopt prohibitory rules, including rules limiting emissions from stationary sources.[71] This district authority includes authority to adopt rules and regulations limiting emissions from existing stationary sources by

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[62] Division 26, Part 3, Air Pollution Control Districts.

[63] Division 26, Part 4, Nonvehicular Air Pollution Control.

[64] Section 40001(a).

[65] E.g., section 40001(c), (d) (requirement for district determination that the rule or regulation will promote attainment or maintenance of air quality standards and shall include a process to approve alternatives).

[66] Regulation of the registration and use of pesticides belongs to the Department of Food and Agriculture. Section 39650 (legislative findings regarding toxic air contaminants).

[67] Only sections 41704 (smoke), 41705 (odors), and 42310 (permit systems) contain express exclusions for agricultural operations.

[68] *E.g., City of National City v. Fritz* (1949) 33 Cal.2d 635, 636, cited in *Julius Goldman's Egg City v. Air Pollution Control District of Ventura County* (1981) 116 Cal.App. 3d 741, 746.

[69] *Julius Goldman's Egg City* at 746.

[70] Section 39002.

[71] Sections 40001(a), 40702.

requiring those sources to install RACT or BARCT.[72] No statutory provision limits the types of stationary sources subject to RACT and BARCT requirements.[73] To the particular point at issue here, no statutory provision prohibits districts from requiring RACT or BARCT for stationary sources used in agricultural operations.

District authority to adopt rules and regulations also includes authority to recover costs of evaluating plans required by district rule or regulation, even for sources not included within a permit system.[74] Districts may adopt by regulation fee schedules to cover funding of district programs.[75] Districts may adopt by regulation fee schedules to cover the costs of sampling and analysis to determine compliance with local rules or regulations relating to air pollution.[76] Just as with adoption of prohibitory rules, nothing in the districts' authorities to recover costs excludes stationary sources used in agricultural operations.

District authority to adopt rules and regulations includes district authority to implement and enforce those rules and regulations. As outlined above, numerous provisions in Division 26 authorize districts to bring enforcement actions against sources that violate statutory provisions or district rules, regulations, or orders.[77] Enforcement actions are not limited as to source category and, relevant to the question at hand, enforcement actions are not limited to sources subject to a district permit program established under section 42300. Therefore, districts may take enforcement actions against stationary sources used in agricultural operations if those sources are not in compliance with district rules and regulations, except that districts may not impose requirements on such sources through district permitting systems.

Second Question Presented: Could a district impose registration requirements and registration fees for stationary sources used in agricultural operations?

Issue: Because registration requirements and registration fees might closely resemble permit requirements and permit fees, could registration programs for stationary sources used in agricultural operations be seen as attempts to circumvent the statutory permit exemption for stationary sources used in agricultural operations? Because the legislature expressly authorized registration programs for portable equipment, must registration programs for other types of sources also be expressly authorized?

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[72] Sections 40918, 40919, 40920, 40920.5.

[73] See e.g., section 40918(a)(2).

[74] Section 41512.5.

[75] Sections 40131, 40702.

[76] Section 41512.

[77] These enforcement provisions also apply to violations of permits. See, e.g. section 42400.

Analysis: Authority to adopt and enforce rules and regulations includes authority to devise a reasonable implementation program to enable enforcement of that program. Otherwise, the rules and regulations would be meaningless paper requirements. A reasonable implementation program might include requirements for registration of sources to facilitate management and administration of the district's responsibilities.[78] Nothing in the Health and Safety Code expressly prohibits districts from establishing a registration program for stationary sources not included within a permitting system. In fact, some districts already have registration programs for certain sources separate from the district permit program.[79] In addition, although the Health and Safety Code authorizes districts to establish a permit system,[80] districts are not required to do so. Because district rules and regulations must be enforceable, districts are free to devise enforcement mechanisms other than a permit system. Districts are expressly authorized to adopt fee schedules for sources not included within a permit system to cover the costs of reviewing, monitoring, and enforcing plans required by law or by district rule or regulation.[81] Therefore, a district may establish a registration program by regulation and may charge fees to cover costs of implementing and enforcing that program. Furthermore, if a district concludes that a registration program will enable it to enforce RACT or BARCT requirements for stationary sources used in agricultural operations, nothing in the statute expressly or implicitly precludes a district from establishing such a program.

In 1996, the Legislature added provisions to the Health and Safety Code requiring ARB to establish an optional registration program for portable engines.[82] This voluntary system of statewide registration and regulation of portable equipment, including portable IC engines, requires ARB to, among other things, establish control requirements, a fee schedule to recover costs of enforcement, and regulations to establish best available control technology emission limits.[83] The statewide program is enforced by the districts "in the same manner as a district rule or regulation."[84] However, nothing in these provisions denotes the portable equipment registration program as the only registration program the districts may administer. Rather, the Legislature declared that this program was necessary for a specific purpose--to establish uniform statewide regulation of engines used at various locations throughout the state.[85] Unlike portable engines which move from place to place, stationary sources used in agricultural operations may

[78] Section 40702.

[79] E.g., San Diego APCD Rule 12, Registration of Specified Equipment, Monterey Bay UAPCD Rule 201, Sources Not Requiring Permits.

[80] Section 42300.

[81] Section 41512.5.

[82] Sections 41750-55. The Health and Safety Code also expressly authorizes a separate registration system for emission offset banking. Sections 40709, 40711.

[83] *Id.*

[84] Section 41755(a).

[85] Section 41750.

reasonably be subject to a district mechanism for implementation and enforcement of RACT and BARCT requirements, as long as this mechanism is not a district permitting system. The Legislature could have, but did not, prohibit districts from establishing registration programs for sources other than portable engines. Therefore, no express statutory authorization is necessary for district registration programs for stationary sources used in agricultural operations.

Third Question Presented: What types of enforcement options would be available to a district if a source is out of compliance; for example, could a district impose fines, issue variances, or issue abatement orders?

Issue: If a district relies entirely on its permit system for enforcement of district rules and regulations, the district may be lacking enforcement mechanisms for nonpermitted sources. May a district that now relies entirely on a permitting system for enforcement of district rules and regulations applicable to stationary sources nevertheless establish additional enforcement mechanisms for nonpermitted sources if those sources are subject to district rules and regulations?

Analysis: The Health and Safety Code expressly authorizes districts to use a number of mechanisms to enforce against violations of district rules, regulations, or orders, including imposing fines,[86] issuing variances,[87] and issuing abatement orders.[88] Each statutory enforcement provision expressly includes violations of district rules, regulations, permits, or orders and nowhere excludes violations of rules, regulations, or orders applicable to stationary sources used in agricultural operations. However, if a district now relies entirely on its permit system for enforcement of requirements applicable to stationary sources, the district would need to establish additional enforcement mechanisms to ensure compliance with RACT and BARCT requirements for stationary sources used in agricultural operations. A district would need first to establish RACT and BARCT requirements by regulation. These emission control requirements would then be enforceable through district regulations governing fines, variances, and abatement orders.

The Health and Safety Code specifically authorizes any person to apply for a variance from either section 41701 (prohibition against discharge of contaminants exceeding smoke and opacity limits) or from the rules and regulations of a district.[89] For a source used in agricultural operations, which is already exempted from section 41701,[90] this provision is explicit authorization to apply for a variance from the rules and regulations of a district for that source.

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[86] See, e.g. sections 42400-42409.

[87] See, e.g. sections 42350-42364.

[88] See, e.g. section 42450-42454.

[89] Section 42350.

[90] Section 41704(g), (h).

CONCLUSION

We conclude that a district may adopt prohibitory rules, recover costs, and take enforcement actions for stationary sources used in agricultural operations, including stationary IC engines. A district may impose registration requirements, registration fees, and fines and may issue variances and abatement orders for such sources. The mere fact that a district has chosen to establish a permitting system to enforce requirements for some of the stationary sources in the district does not preclude the district from establishing and using a different enforcement mechanism for sources statutorily exempted from the district permitting system.

APPENDIX G

SUMMARY OF PUBLIC WORKSHOP HELD ON AUGUST 29, 2000

Workshop Summary

Workshop: Public Workshop on the Proposed Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology (RACT/BARCT) for Stationary Spark-Ignited Internal Combustion Engines

Date: August 29, 2000

Location: 2020 L Street, Board Hearing Room
Sacramento, California

Purpose: This meeting was held to provide an update to, and receive comments on the Proposed Determination of RACT/BARCT for Stationary Spark-Ignited Internal Combustion Engines

Attendees: Approximately 22 people attended the workshop. The attendees included 8 representatives from companies involved in the operation of internal combustion engines, 2 from engine manufacturers, and one from a manufacturer of emission controls. The remaining attendees represented ARB, three air districts, and U.S. EPA.

Key Points: ARB staff made a short presentation on the Proposed Determination of RACT/BARCT for Stationary Spark-Ignited Internal Combustion Engines. This included an overview of the proposed determination and an explanation of the emission limits and other requirements.

The main comments from the industry representatives included:

? Engines de-rated below 50 horsepower should be exempted from the document.
? Source testing is relatively expensive and can be a significant financial burden.
? Source test data included in the document may not be representative of “real world” operating conditions.
? There are serious problems in using catalysts and fuel meters on field gas-fueled engines because the gas contains sulfur, moisture and other contaminants.
? There are issues with electrification because of the installation costs, power shortages in California and consequent rising electrical power rates.
? Existing two-stroke Ajax engines cannot meet the proposed emission standards, and there is no technology which can reduce their emissions effectively.
? Engines with Pre-stratified Charge control technology should be treated as lean burn engines since their air-to-fuel ratio is in the lean burn regime.
? The low fuel consumption threshold should be based on the minimum operating temperature of the catalyst.

Summary: Staff will continue to look into these issues by visiting various sites in California.