VALIDATION AND APPLICATION PROTOCOL FOR SOURCE APPORTIONMENT OF PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS) AMBIENT VOLATILE ORGANIC COMPOUUND (VOC) DATA

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TABLE OF CONTENTS

Page No.

Acknowledgment and Disclaimers ii
List of Tables v
List of Figures v

1.0 INTRODUCTION 1-1
- 1.1 Background 1-1
- 1.2 CMB Receptor Modeling 1-3
  - 1.2.1 Fundamentals 1-3
- 1.3 CMB Software History and Recent Changes 1-4
- 1.4 Guide to Report 1-6

2.0 MEASUREMENT OF VOLATILE ORGANIC COMPOUNDS IN AMBIENT SAMPLES 2-1
- 2.1 Photochemical Assessment Monitoring Station (PAMS) Measurements of Ambient Volatile Organic Compounds 2-1
- 2.2 Definition of Volatile Organic Compounds 2-2
- 2.3 Sampling and Analysis Methods 2-4
  - 2.3.1 Collection and Analysis of Hydrocarbons and Nonmethane Organic Compounds (NMOC) 2-5
  - 2.3.2 Carbonyl Compounds 2-6
  - 2.3.3 C_8-C_{20} Hydrocarbons by Tenax Sampling and Analysis by GC/FID or GC/MS 2-7
- 2.4 Data Validation 2-7
  - 2.4.1 Level 0 Validation 2-8
  - 2.4.2 Level 1 Validation 2-8
  - 2.4.3 Level 2 Validation 2-9
  - 2.4.4 Level 3 Validation 2-9
  - 2.4.5 External Performance Audits and Comparison Studies 2-10

3.0 VOC SOURCE COMPOSITION PROFILES 3-1
- 3.1 Source Composition Profile Normalization and Uncertainties 3-1
- 3.2 Review and Preparation of Source Profile CMB Input File Using the Source Profile Library 3-2
- 3.3 Source Composition Profile Categories 3-3
  - 3.3.1 Vehicle Exhaust 3-4
  - 3.3.2 Cold-Start Emissions 3-8
  - 3.3.3 Gasoline Liquid and Vapor 3-8
  - 3.3.4 Commercial Natural Gas and Liquefied Petroleum Gas 3-12
  - 3.3.5 Surface Coatings 3-12
  - 3.3.6 Organic Decay and Landfills 3-13
  - 3.3.7 Meat Cooking and Residential Wood Combustion 3-14
  - 3.3.8 Industrial Sources 3-14

3.3.9 Coal-Fired Power Stations....3-16
3.3.10 Biogenic Emissions....3-16
3.3.11 Regional Background....3-16
3.3.12 Unidentified....3-17

4.0 APPLICATION OF CMB TO PAMS AMBIENT VOC DATA....4-1
4.1 Preparing CMB Input Files....4-1
4.1.1 Input Filename....4-2
4.1.2 Source, Species, and Sample Selection Input Files....4-3
4.1.3 Generating CMB-Ready Input Files Using Macros in SoureProfileLibrary.xls....4-6
4.1.4 Ambient Data Input File....4-6
4.1.5 Source Profile Input File....4-7
4.2 Output Files....4-8
4.2.1 Report Output File....4-8
4.2.2 Data Base Output File....4-8
4.2.3 Reading Output Files....4-9

5.0 CMB APPLICATION AND VALIDATION....5-1
5.1 CMB Model Applicability....5-1
5.2 Initial Source Contribution Estimates....5-2
5.3 Model Outputs and Performance Measures....5-4
5.4 Deviations from Model Assumptions....5-6
5.5 Identification and Correction of Model Input Errors....5-9
5.6 Consistency and Stability of Source Contributions....5-9

6.0 REFERENCES....6-1

Appendix A. Organic Analysis Parameter List....A-1
Appendix B. List of Source Composition Profiles....B-1

LIST OF TABLES

Page

Table 2-1 Atmospheric Lifetimes of PAMS Target Species 2-11

Table 2-2 Relative Emissions of Ethene and Vehicle Exhaust from Dynamometer and Tunnel Measurements 2-12

Table 4-1 Recommended Fitting Species 4-10

Table 5-1 Example CMB8 Output 5-10

LIST OF FIGURES

Page

Figure 2-1 Scatterplot of ethylene versus acetylene for morning and afternoon samples at Azusa 2-13

Figure 5-1. Average source contribution estimates of ambient hydrocarbons at Rider College, NJ during summer, 1995 by time of day. Source: Fujita and Lu, 1998 . 5-12

Figure 5-2. Average source contribution estimates of hydrocarbons at Rider College, NJ during summer, 1995 (EDT) by day of the week. Source: Fujita and Lu, 1998... 5-12

Figure 5-3. Wind directional dependence of source contributions by time of the day at Rider College, NJ during summer, 1995. 5-13

Figure 5-4. Scatterplots of Calculated Versus Measured Hydrocarbon Concentrations for samples collected at Azusa for the CARB Study. 5-14

Figure 5-5. Scatterplots of Calculated Versus Measured Hydrocarbon Concentrations for samples collected at Los Angeles – North Main for the CARB Study. 5-15

1. INTRODUCTION

This document provides a protocol for applying the Chemical Mass Balance (CMB) receptor model to Photochemical Assessment Monitoring Station (PAMS) volatile organic compound (VOC) data and for evaluating and interpreting model outputs. The guidance includes a summary of the fundamentals of CMB, descriptions of the features of CMB Version 8 (Watson et al., 1997), and sample CMB Version 8 VOC source and ambient input data files, default source and fitting species selection files, and a current library of available source VOC composition profiles in CMB8-ready format. The applications and validation protocol provides recommended procedures for validating ambient VOC data, assigning uncertainties to ambient and source measurements, selecting and evaluating source composition profiles and fitting species, evaluating and validating model outputs, and analyzing and interpreting the CMB source contribution estimates and associated uncertainties. The CMB applications and validation protocol developed by Watson et al. (1998) was adapted here for application to PAMS and similar VOC data.

The actual profiles are available electronically in the file CMBProfilesLibrary.XLS. This library is a compilation of source profiles that have been used by the Desert Research Institute in prior VOC source apportionment studies. They include profiles that were newly developed for specific studies, the literature, and from the California Air Resources Boards Modeling Emissions Data System (MEDS). Studies for which profiles were newly developed include the 1993 Coast Oxidant Assessment for Southeast Texas (Fujita et al., 1995b), 1995 Boston and Los Angeles VOC Source Apportionment Study (Fujita et al. 1997a), 1995/96 Washington Ozone Transport Study (Fujita et al., 1997c), 1996 El Paso/Juarez Ozone Study (Fujita, 2001; Seila et al., 2001), and 1998 Central Texas On-Road Hydrocarbon Study (1999a), 1999 VOC Source Signatures in Houston, TX (Fujita et al., 1999b), apportionment of 1994-97 South Coast Air Basin PAMS VOC data (Fujita and Campbell, 2003b), and the 2000 Weekend Ozone Observations in the South Coast Air Basin (Fujita et al. 2002; Fujita et al., 2003a). The document and supporting files are intended to facilitate and encourage the application of the CMB receptor model to PAMS VOC data by State and Local air pollution agencies as an evaluation of emissions inventories.

This document, the CMBProfilesLibrary file and a self-extracting zipfile (SoCAB.exe) containing sample CMB input files with ambient and source VOC datasets for California's South Coast Air Basin are available at the Desert Research Institute web site at http://www.dri.edu/People/ericf/. Specific questions and comments regarding this document and sample datasets may be addressed to Dr. Eric Fujita at ericf@dri.edu. The CMB software is available at the TTN web site at http://www.epa.gov/scram001/tt23.htm. Questions regarding the CMB software should be directed to Dr. John Watson at DRI at johnw@dri.edu.

1.1 Background

The role of VOCs in the formation of tropospheric ozone has been well established (Seinfeld, 1986). The only significant chemical reaction producing ozone in the atmosphere is the reaction of atomic and molecular oxygen. While molecular oxygen (O_2) is abundant in the atmosphere, free oxygen (O) atoms are not. At high altitudes (above 20 km) free oxygen atoms are produced by photodissociation of molecular oxygen by radiation in the deep ultraviolet. At lower altitudes, where only radiation with wavelengths greater than 280 nm is present, the only significant oxygen atom production is from photodissociation of nitrogen dioxide into nitrogen oxide and atomic oxygen. The nitrogen oxide reacts rapidly with ozone to regenerate nitrogen dioxide. In the lower atmosphere, these three reactions occur rapidly, establishing a steady-state equilibrium ozone concentration that depends on the ratio of nitrogen dioxide to nitrogen oxide. One ozone molecule is required to regenerate nitrogen dioxide from nitrogen oxide, so these reactions are insufficient by themselves to create excessive ozone levels. A reaction path that converts nitrogen oxide back to nitrogen dioxide without consuming a molecule of ozone is provided by the presence of reactive organic gases. The organic radicals produced in the oxidation of organic gases react with nitrogen oxide to form nitrogen dioxide, thereby shifting the equilibrium, which allows ozone to accumulate. Aside from meteorology and transport, emissions of nitrogen oxides and reactive organic gases (ROG) are the main factors that affect ozone levels in urban areas, and these are the primary focus of control programs that have been developed to attain federal and state air quality standards for ozone. Without anthropogenic nitrogen oxides emissions, the hourly concentration of ozone in the troposphere would not exceed background levels of 20 to 50 ppb. Even with the presence of nitrogen oxides, ozone would not reach the levels of the current ambient standard for ozone if it were not for the effects of ROG.

Ambient air quality surveillance regulation in title 40 Part 58 of the Code of Federal Regulations require the states to establish Photochemical Assessment Monitoring Stations (PAMS) in affected nonattainment areas for enhanced monitoring of ozone and its precursors including oxides of nitrogen (NOx), speciated volatile organic compounds (VOCs), and meteorological parameters. States with areas classified as serious, severe, or extreme for ozone nonattainment were required to establish PAMS as part of their State Implementation Plans. The program was phased-in over a five-year schedule, which began in 1994, at a rate of at least one station per area per year. Design criteria for the PAMS network are based on selection of an array of site locations (a maximum of five depending upon population) relative to ozone precursor source areas and predominant wind directions associated with high ozone events. Intended applications for the PAMS data base include ozone and precursor trends, emission inventory reconciliation and evaluation, population exposure analyses, photochemical modeling support, and control strategy evaluation. In parallel with the implementation of PAMS, existing data analysis methods will need to be evaluated with respect to the data analysis objectives for the program.

This document reviews the applicability of the Chemical Mass Balance (CMB) receptor modeling and available source composition profiles for estimating source contribution to ambient VOCs using data from the PAMS networks. Watson et al. (2002) recently examined how the CMB receptor model has been applied to quantify ambient VOC source contributions to ambient concentrations of VOC for the North American Research Strategy for Tropospheric Ozone (NARSTO) critical review. This review explains how CMB source contribution estimates have been used to evaluate ROG emissions inventories used in ozone models and identifies several deficiencies and inconsistencies in source composition databases, source and receptor measurement strategies, and data reporting conventions.

1.2 CMB Receptor Modeling

The Chemical Mass Balance (CMB) receptor model uses the chemical and physical characteristics of gases and particles measured at source and receptor to both identify the presence of and to quantify source contributions of pollutants measured at the receptor. The CMB model consists of a least-squares solution to a set of linear equations that expresses each receptor concentration of a chemical species as a linear sum of products of source profile species and source contributions. The source profile species (the fractional amount of each species in the VOC emissions from a given source type) and the receptor concentrations, each with uncertainty estimates, serve as input data to the CMB model. The output consists of the contributions of each source type to both total and individual ambient VOC concentrations. The model calculates values for contributions from each source and the uncertainties of those values. Input data uncertainties are used both to weight the relative importance of the input data to the model solution and to estimate uncertainties of the source contributions.

1.2.1 Fundamentals

The CMB procedure requires: 1) identification of the contributing source types; 2) selection of chemical species to be included; 3) estimation of the fractions of each chemical species contained in each source type; 4) estimation of the uncertainties to both ambient concentrations and source compositions; and 5) solution of the chemical mass balance equations. The CMB model assumes that: 1) compositions of source emissions are constant over the period of ambient and source sampling; 2) chemical species do not react with each other, i.e., they add linearly; 3) all sources with a potential for significant contribution to the receptor have been identified and have had their emissions characterized; 4) the source compositions are linearly independent of each other; 5) the number of source categories is less than or equal to the number of chemical species; and 6) measurement uncertainties are random, uncorrelated, and normally distributed. These assumptions are fairly restrictive and will never be totally complied within actual practice. Fortunately, the CMB model can tolerate deviations from these assumptions, though these variations increase the stated uncertainties of the source contribution estimates.

Source contribution estimates (SCE) are the main output of the CMB model. The sum of these concentrations approximates the total mass concentrations. Negative SCE are not physically meaningful, but can occur when a source profile is collinear with another profile or when the source contribution is close to zero. Collinearity is usually identified in the similarity/uncertainty cluster display. When the SCE is less than its standard error, the source contribution is undetectable. Two or three times the standard error may be taken as the upper limit of the SCE in this case. Assuming that the errors are normally distributed, there is about a 66% probability that the true source contribution is within one standard error and about a 95% probability that the true concentration is within two standard errors of the SCE. The reduced chi square (χ^2), R^2 , and percent mass are goodness of fit measures for the least-squares calculation. The χ^2 is the weighted sum of squares of the differences between calculated and measured fitting species concentrations divided by the effective variance and the degrees of freedom. The weighting is inversely proportional to the squares of the precision in the source profiles and ambient data for each species. Ideally, there would be no difference between calculated and measured species concentrations and χ^2 would be zero. A value of less than one indicates a very good fit to the data, while values between 1 and 2 are acceptable. χ^2 values greater than 4 indicate that one or more of the fitting species concentrations are not well-explained by the source contribution estimates. R^2 is determined by the linear regression of the measured versus model-calculated values for the fitting species. R^2 ranges from 0 to 1. The closer the value is to 1.0, the better the SCEs explain the measured concentrations. When R^2 is less than 0.8, the SCEs do not explain the observations very well with the given source profiles. Percent mass is the percent ratio of the sum of model-calculated SCEs to the measured mass concentration. This ratio should equal 100%, though values ranging from 80 to 120% are acceptable.

1.3 CMB Software History and Recent Changes

The Chemical Mass Balance receptor model was first applied by Winchester and Nifong (1971), Hidy and Friedlander (1972), and Kneip et al. (1972). The original applications used unique chemical species associated with each source-type, Freidlander (1973) introduced the ordinary weighted least-squares solution to the CMB equations, and this had the advantage of relaxing the constraints of a unique species in each source-type and of providing estimates of uncertainties associated with the source contributions. The ordinary weighed least squares solution considered only the uncertainties of the receptor concentrations. The uncertainties of the source profiles, which are typically much higher than the uncertainties of the receptor concentrations, were neglected.

The first user-oriented software for the CMB model was programmed in 1978 at the Oregon Graduate Center in FORTRAN IV on a PRIME 300 minicomputer (Watson, 1979). CMB Version 7 (CMB7) was completely rewritten in a combination of C and FORTRAN languages to operate with microcomputers. This version of the software applied the effective variance solution developed and tested by Watson et al. (1984). This method gives greater influence in the solution to chemical species that are measured more precisely in both source and receptor samples, and calculates uncertainties for source contributions from both the source and receptor uncertainties. The software also incorporated collinearity measures (Henry, 1982, 1992) to assess the effects of source profile similarity on source contribution estimates and their standard errors.

CMB7 was not originally tailored for apportionment of VOCs, nor for processing thousands of samples in an automated mode. The CMB7 contains an “AUTOFIT” option that calculates source contribution estimates for selected samples with a given configuration of fitting sources and species without operator intervention. AUTOFIT in version 7.0 provides accurate results when applied to two particle size fractions, such as fine and coarse particle sizes from dichotomous sampler data. However, when CMB7 was applied to the Southern California Air Quality Study VOC data (Fujita et al, 1994), a bug in AUTOFIT was discovered that manifests itself as a mismatch between receptor site identifiers and computed source contributions when only one size fraction is used. Since VOC data does not use particle size options in CMB7, the fit returns with the correct site identifier but with the last previously computed source contributions. Subsequent fits advance both site identifier and contributions correctly but retain the mismatch. CMB7 was upgraded to Version 7.2 by DRI (Robinson, 1995) for the Texas Natural Resource Conservation Commission to apportion ambient hydrocarbon as part of the

Coastal Oxidant Assessment for Southeast Texas (COAST) Study (Fujita, et al., 1995b). The major modifications are summarized below:

- The bug in the AUTOFIT routine was corrected. Sample IDs correspond to the correct calculation.
- Species missing in either the receptor site data or a fitting source profile are eliminated from the fit, then added back for subsequent calculations.
- CMB7.2 outputs all results to a comma-delimited temporary file sumdir.dat. This file contains: 1) ambient data records; 2) fitting elements; 3) fitting sources; 4) source contributions; 5) source contribution uncertainties; 6) calculated elemental concentrations; and 7) calculated elemental concentration uncertainties. This file facilitates subsequent data analysis and plots.
- Additional options were added. They include: 1) AUTOFIT - this selects all receptor sites and performs an autofit; 2) AUTOSOURCEFIT - this eliminates fitting sources with negative source contributions, and/or sources belonging to similarity clusters with standard errors > source contribution; 3) WRITEALL - print out all fits to CMBOUT.DT1; 4) WRITEOFF - suppresses the print output in AUTOFIT; 5) PDATA will write the size TOTAL output if a prior fit has been made to the same receptor site with identical fitting elements and sources; and 6) EXIT - exit program.

Although CMB7.2 made more options available, the improvements over CMB7 were required to meet the immediate needs of the COAST data analysis. The current version, CMB8, was developed at Desert Research Institute under EPA sponsorship (EPA Contract 5D1808NAEX). The new software operates under MS-Window (in both 16 and 32 bit versions), is more user friendly, and includes more data input and output options. The major modifications are summarized below:

- Options for using comma-separated value (CSV), xBASE (DBF), and Lotus spreadsheet (WKS) input files, in addition to CMB7 style blank delimited files.
- An option to change the default name of the report output file, which had the default name of CMBOUT.DT1 in CMB7. In CMB8 the default name is CMBOUTRP.TXT and both the suffix and prefix may be changed.
- An option to change the default name of the flat ASCII data file, which had the default name of CMBOUT.DT2 in CMB7. In CMB8 the default name is CMBOUTDB.TXT and the prefix may be changed from the default. Options for changing the type of this output file from the blank delimited CMB7 style have also been added to the options menu. If Comma Separate Values (CSV), xBASE (DBF), or Lotus 123 (WKS) options are chosen in the options menu, output files with suffixes CSV, DBF, or WKS are written in place of the default suffix TXT.
- An option to preselect ten default sets of fitting species. Default selections appear in a pop-up window where the ten default selections of fitting species are displayed and

selected by clicking on the appropriate radio button appearing across the top row. The default selections can be modified in an edit box where the selections are displayed.

- An option to preselect ten default sets of sources. Default selections appear in a pop-up window where the ten default selections of sources are displayed and selected by clicking on the appropriate radio button appearing across the top row. The default selections can be modified in an edit box where the selections are displayed.

- An option to eliminate sources automatically from the fit that have negative contributions, or inestimable sources that have uncertainties larger than their contribution. Sources are eliminated one at a time with fits performed after each elimination until no source fails the tests. Specifically, CMB8 first tests for negative contributions and eliminates the source with the largest negative contribution, if one exists. When no sources with negative contributions are left, CMB8 tests for inestimable sources with uncertainties larger than the source contribution. If any are found, CMB8 eliminates the source with the largest ratio of uncertainty to contribution.

The CMB8 software is interactive, allowing many sensitivity and assumptions-testing calculations to be performed rapidly. A user's manual (Watson et al., 1997) describes how to operate the CMB8 software, and a separate applications and validation protocol (Watson et al., 1998) describes how to apply CMB8 to specific situations and how to evaluate its outputs. Additional specific guidance is provided in this document in applying the applications and validation protocol for source apportionment of VOC using PAMS data.

1.4 Guide to Report

Section 1 introduces CMB and the scope of this document. Section 2 describes the sampling and analysis methods used to obtain the source and ambient VOC composition data. Section 3 reviews currently available source composition profiles and their applicability for apportionment of PAMS VOC data. Section 4 describes the input and output files for applying PAMS VOC data to CMB8. Finally, CMB application and validation protocol steps are reviewed in Section 5.

2. MEASUREMENT OF VOLATILE ORGANIC COMPOUNDS IN AMBIENT SAMPLES

This section describes current monitoring programs and analytical methods for measuring speciated volatile organic compounds in the ambient air. Quality assurance programs and data from laboratory comparisons are reviewed to determine variations among PAMS networks in the operational definition of total nonmethane hydrocarbon. Procedures are recommended for estimating analytical data uncertainties, preparing CMB input-ready databases from VOC downloaded from the Aerometric Information Retrieval System (AIRS), and performing data validation checks.

2.1 Photochemical Assessment Monitoring Station (PAMS) Measurements of Ambient Volatile Organic Compounds

Volatile organic compounds play a central role in the formation of ozone (O_3) because their oxidation produces hydroperoxy radicals (HO_2) and organic peroxy radicals (RO_2) which react with NO to form NO2 without destruction of ozone, thereby allowing ozone to accumulate. In addition to directly emitted VOCs, carbonyl compounds that are produced from hydrocarbon oxidation can be important reactive VOCs themselves, and thus important sources of peroxy radicals responsible for ozone production. Much of the difficulty in addressing the ozone problem is related to this complex photochemistry. The rate of O_3 production is a non-linear function of the mixture of VOC and NOx in the atmosphere. Depending upon the relative concentration of VOC and NOx and the specific mix of VOC present, the rate of O_3 formation can be most sensitive to changes in VOC alone or to changes in NOx alone or to simultaneous changes in both VOC and NOx. Understanding the response of ozone levels to specific changes in VOC or NOx emissions is the fundamental prerequisite to developing a cost-effective ozone abatement strategy.

In the 1970s and 1980s, the empirical kinetic model, EKMA, was commonly used to examine the nonlinear relationship between VOC, NOx and ozone, and to estimate the relative effects of alternative emission reduction scenarios on ambient ozone levels. The U.S. Environmental Protection Agency initiated a program in 1984 to provide total nonmethane organic compound (NMOC) data for use in EKMA. This NMOC program involved the weekday collection of samples during the 0600-0900 (local time) between June 1 and September 30. The samples were shipped to a central laboratory in Research Triangle Park, NC, for analysis. In 1991, at the request of some of the participating agencies, the program was expanded to include speciation of up to 78 individual hydrocarbon species. This expansion followed the development of air quality simulation models and their application in major air quality studies such as the 1987 Southern California Air Quality Study, 1990 San Joaquin Valley Air Quality Study, 1990 Southern Oxidants Study in Atlanta, 1991 Lake Michigan Study, 1993 Coastal Oxidant Assessment for Southeast Texas, and, more recently, the 1995/96 NARTSO-Northeast Ozone Study, 1995 Nashville/Middle Tennessee Ozone Study, 1996 Paso del Norte Ozone Study, 1996 Phoenix Ozone Study, 1995/96 Western Washington Ozone Precursor Transport Study, 1997 Southern California Ozone Study-NARSTO, 2000 Central California Ozone Study, and the Texas 2000 Study.

Under Title I, Section 182, of the 1990 Amendments to the Federal Clean Air Act, the EPA proposed a rule to implement a national network of enhanced ambient air monitoring stations (Federal Register, 1993). States with areas classified as serious, severe, or extreme for ozone nonattainment were required to establish Photochemical Assessment Monitoring Stations (PAMS) as part of their State Implementation Plan. Each station measures speciated hydrocarbons, ozone, oxides of nitrogen, and surface meteorological data. Carbonyl compounds are measured at PAMS sites located in the source regions. Additionally, each area must monitor upper air meteorology at one representative site. The PAMS sites were phased in over a five-year period beginning in 1993.

Design criteria for the PAMS network are based on selection of an array of site locations relative to ozone precursor source areas and predominant wind directions associated with high ozone events. Specific monitoring objectives are to characterize precursor emission sources within the area (Type 2), transport of ozone and its precursors into (Type 1) and out of the area (Type 3 and 4), and the photochemical processes related to ozone nonattainment, as well as developing an initial urban toxic pollutant database. A maximum of five PAMS sites are required in affected nonattainment areas, depending on the population of the Metropolitan Statistical Area/Consolidated Metropolitan Statistical Area (MSA/CMSA) or nonattainment area, whichever is larger. The intended applications for the PAMS database include ozone and precursor trends, emission inventory reconciliation and verification, population exposure analyses, photochemical modeling support, and control strategy evaluation.

EPA's "Technical Assistance Document for Sampling and Analysis of Ozone Precursors" (U.S. EPA, 1991) specifies modified Methods TO-14 (U.S. EPA, 1999a) and TO-11 (U.S. EPA, 1999b) for sampling and analysis of speciated hydrocarbons and carbonyl compounds, respectively. The minimum list of targeted hydrocarbons currently includes 55 species (Table 2-1). For carbonyl compounds, state and local agencies are currently required to report only formaldehyde, acetaldehyde and acetone. The EPA rule requires eight 3-hour hydrocarbon samples (midnight-3 am, 3-6 am, 6-9 am, 9-noon, noon-3 p.m., 3-6 p.m., 6-9 p.m., and 9-midnight local time) every day at Type 2 sites and every third day at all other PAMS sites. Sampling for carbonyl compounds is required at Type 2 sites only. In addition, one 24-hour sample is required every sixth day year-round at Type 2 sites and during the summer monitoring period at all other sites. Some states such as California have negotiated alternative sampling plans. In the California Alternative plan, four 3-hour samples (3-6 am, 6-9 am, 1-4 p.m., and 5-8 p.m., PDT) are collected every third day during the monitoring period at all PAMS sites for speciated hydrocarbons and at Type 2 sites only for carbonyl compounds. In addition to the regularly scheduled measurements, samples are collected on a forecast basis during up to five high-ozone episodes of at least two consecutive days. Episodic measurements consist of four samples per day (6-9 am, 9-noon, 1-4 p.m. and 5-8 p.m., PDT) for speciated hydrocarbons at all PAMS sites and for carbonyl compounds at Type 2 sites.

2.2 Definition of Volatile Organic Compounds

Accurate measurement of total VOC in ambient samples are important in receptor modeling because these values are used to set the denominator in calculating the fractional contributions of sources to the observed ambient VOC concentrations. Individual species that are characteristic of specific source types, not necessarily the most abundant species, have the greatest influence on the apportionment. In order to determine these quantities accurately, they must be unambiguously and consistently identified for both ambient and source samples.

Several terms are used inconsistently but interchangeably to describe different fractions of atmospheric organic material. Common definitions and units must be used for ambient concentrations, source profiles, and emissions rates. The following terms are defined as they are used throughout this report, and these definitions are recommended for future CMB source apportionment projects:

- Volatile organic compounds (VOC): VOCs are normally defined as all organic compounds that may be present in the ambient air irrespective of their photochemical reactivity or ability of measurement methods to quantify their concentrations. NMHC plus heavy hydrocarbons plus carbonyls plus halocarbons, typically <C20. VOC has been imprecisely used to describe most of the other categories defined below.

- Hydrocarbons: Organic compounds that consist only of carbon and hydrogen atoms. Subclasses of hydrocarbons include alkanes, alkenes, alkynes, and aromatic hydrocarbons. Paraffins and olefins are synonymous with alkanes and alkenes, respectively. All of the 55 target PAMS compounds, shown in Table 2-1, are hydrocarbons. They typically comprise about 70 to 80 percent of total VOC in urban areas. This fraction is less in afternoon samples relative to morning samples and in downwind locations due to photochemical reactions that convert hydrocarbons to oxidized species such as carbonyl compounds and organic acids.

- Halocarbons: Carbon containing compounds with chlorine, fluorine, and bromine compounds attached, quantified from canisters by gas chromatography with electron capture detection (GC-ECD). Methylchloride, methylchloroform, methylbromide, and various refrigerants (Freon-12, Freon-22, SUVA) are most commonly measured. These compounds have long lifetimes and are not reactive enough to cause major changes in tropospheric ozone and secondary organic aerosol. Halocarbons have been implicated in the long-term depletion of stratospheric ozone.

- Nonmethane hydrocarbons (NMHC, also termed “light” hydrocarbons): C_2 through C_{11} (light) hydrocarbons collected in stainless steel canisters and measured by gas chromatography with flame ionization detection (GC-FID) by EPA method TO-14A (U.S. EPA, 1999a). Known halocarbons and oxygenated compounds (e.g., aldehydes, ketones, ethers and alcohols) are excluded from NMHC.

- Heavy hydrocarbons: C_{12} through C_{20} hydrocarbons collected on Tenax adsorbing substrates and analyzed by thermal desorption and gas chromatography with detection by flame ionization or by mass spectrometry. These are sometimes termed “semi-volatile” compounds because the $>C_{15}$ compounds are often found in both gas and particulate phases. Most of the total hydrocarbon mass is measured in the gas phase. The method also measures C_8 through C_{11} hydrocarbons, which can be compared to collocated canister samples for quality assurance purposes. Hydrocarbons in the lowest molecular-weight range may not be quantitative due to less than complete retention on the Tenax cartridge.

- Carbonyls: Aldehydes and ketones, the most common being formaldehyde, acetylaldehyde, and acetone. Carbonyls are operationally defined as C_1 through C_7 oxygenated compounds measured by collection on acidified 2,4-dinitrophenylhydrazine (DNPH)-impregnated C_{18} or silica gel cartridges and analyzed by high performance liquid chromatography with UV detection (HPLC/UV) according to Method TO11A (U.S. EPA, 1999b). PAMS data normally include only formaldehyde, acetaldehyde, and acetone.

- Non-methane organic compounds (NMOC): Sum of quantifiable peaks by EPA method TO-14A, including unidentified species but excluding halocarbons, or by continuous instruments with flame ionization detection. Measured NMOC will be lower for laboratories employing water management. NMOC also refers to the sum of NMHC plus carbonyl compounds by TO-11.

- Reactive organic gases (ROG): Organic gases with potential to react (<30 day half-life) with the hydroxyl radical and other chemicals, resulting in ozone and secondary organic aerosol. The most reactive chemicals are not necessarily the largest contributors to undesirable end-products, however, as this depends on the magnitude of their emissions as well as on their reactivity. ROG is commonly used in connection with emission inventory data.

- Total organic gases (TOG): Organic gases with and without high hydroxyl reactivity. TOG typically includes ROG plus methane and halocarbons. TOG is commonly used in connection with emission inventory data.

Appendix A lists the volatile organic compounds that are quantified by the Desert Research Institute by measurement method.

2.3 Sampling and Analysis Methods

The experiences from laboratory comparisons that were conducted for COAST (Fujita et al., 1995a), NARSTO-Northeast (Fujita et al., 1997b), and SCOS97-NARSTO (Fujita et al., 1999c; Fujita et al., 2003c) demonstrate that measurements of ambient hydrocarbon speciation are not routine, and that the quality and completeness of measurements vary among different laboratories using essentially the same samplers and analytical instrumentation. Potential problems include: positive and negative artifacts due to sampler or sampling media; incomplete resolution or loss of C_2-C_3 hydrocarbons due to introduction of excess moisture in the column or improper sample loading and injection; under-reporting of true concentrations due to selection of incorrect integration thresholds; loss of material in the analytical system due to poor chromatographic technique (particularly for very light and heavy hydrocarbons) or prolonged storage in canisters prior to analysis (especially olefins and polar organics); incorrect or incomplete peak identification due to limitations of peak identification software (particularly for olefins and $>C_8$ hydrocarbons); systematic bias due to calibration problems; and poor carbonyl compound measurement precision due to variable blanks. These comparison studies show that the values reported for the 55 PAMS target species are generally consistent among the various PAMS analytical laboratories. However, there often exist considerable variations for total nonmethane hydrocarbons (NMHC) or nonmethane organic compounds (NMOC) due to differences in analytical and data processing procedures. Quantifications of NMHC and NMOC are (NMHC) are important values in receptor modeling because they are used to set the denominator in calculating the fractional contributions of sources to the observed ambient concentrations. This section summarizes the sampling and analysis methods that are commonly employed in PAMS to determine ambient VOCs.

2.3.1 Collection and Analysis of Hydrocarbons and Nonmethane Organic Compounds (NMOC)

Analytical methods that are used in the PAMS program for hydrocarbons can be divided into two groups - canister sampling followed by gas chromatographic analysis with flame ionization detection (Method TO-14) and automated gas chromatography. Laboratories that used the canister approach employed commercial gas chromatographic systems equipped with flame ionization detectors (GC-FID), a cryogenic concentration step, and computerized data acquisition systems. Automated, semi-continuous hydrocarbon speciation is performed using a commercial automated gas chromatograph (e.g., Perkin Elmer ATD 400 concentrator coupled to a Perkin Elmer 5700 or 8700 gas chromatograph). In this arrangement, ambient samples are collected each hour over a 40-minute period on a sorbent trap of Carbotrap C and Carbosieve S III. The desorbed sample first goes onto a narrow bore BP-1 methyl silicone column. Lighter compounds are allowed to migrate through the BP-1 column onto an aluminum oxide and sodium sulfate PLOT column for separation. The BP-1 column effluent is switched from the PLOT column to a restrictor and a second FID detector immediately before the elution of hexane. Both columns are then eluted into a separate FID to detect the compound of interest.

Procedures used for instrument calibration varies among PAMS networks. For calibration of the FID, propane is commonly used for C_2 to C_4 hydrocarbons and benzene or hexane is used for greater than C_4 hydrocarbons. The automated gas chromatographs are calibrated against the average response of several hydrocarbons for hydrocarbons eluting before hexane and against the average response of a different group of hydrocarbons for all other targeted hydrocarbons. The systematic differences resulting from variations in FID response among different calibration gases are typically less than 5 percent. Besides selection of the endpoint of the gas chromatographic run, the primary factors that can affect total measured concentrations include selection of threshold levels for peak integration and losses during cryogenic concentration/desorption and surface adsorption within the inlet system. Measurement calibration is normally verified by challenging the measurement/analysis system with a known standard sample that is traceable to a primary standard. Identification of individual compounds in an air sample is usually based on the comparison of linear retention indices (RI) with those RI values of authentic standard compounds, as well as with the RI values obtained by other laboratories performing the same type of analysis using the same chromatographic conditions. The gas chromatograph is connected to a data acquisition system. The software performs data acquisition, peak integration and identification, hardcopy output, post-run calculations, calibrations, peak re-integration, and user program interfacing. Typically, over 85% of total detectable C_2-C_{12} hydrocarbon mass is identified and quantified in urban samples. The detection limit for hydrocarbon VOC is approximately 0.1 ppbC for each compound. Methyl t-butyl ether and several other oxygenated organic compounds may be quantified from canister samples using individual response factor that are specific to each compounds.

2.3.2 Carbonyl Compounds

Carbonyl compounds are involved in photochemical reactions as products of the oxidation of hydrocarbons, precursors of ozone and other oxidants, and as sources of free radicals and organic aerosols. Formation of carbonyl compounds in the atmosphere proceeds through a series of free-radical reactions, which is usually initiated through reaction of hydroxyl radical with a hydrocarbon. The amount and composition of both hydrocarbons and carbonyls strongly influences the rate of NO_X oxidation and ozone formation in the atmosphere (Fung and Grosjean 1981). In addition to in situ photochemical generation, carbonyls are directly emitted from automotive and stationary sources as a result of incomplete combustion, industrial emissions from manufacturing and usage of these compounds, and from biogenic sources. The understanding and assessment of the role of carbonyl compounds in tropospheric chemistry require accurate and precise measurement of these compounds along with their parent and product compounds.

Measurement of carbonyl compounds in the ambient atmosphere poses challenging problems because of their trace concentrations and interferences arising from atmospheric copollutants. The standard method used in PAMS to measure carbonyl compounds involves derivatization of carbonyl compounds by 2,4-dinitrophenylhydrazine (DNPH) followed by liquid chromatography and U.V. detection according to EPA Compendium Method TO-11. The method recommends DNPH-impregnated silica Sep-Pak cartridges with an ozone scrubber upstream of the impregnated cartridge since silica cartridges were found to have significant negative ozone artifacts (Arnst and Tejada, 1989).

Collection of carbonyl compounds by the DNPH method is based on the acid-catalyzed derivatization of carbonyls by nucleophilic addition of the DNPH to a C=O bond, followed by 1,2-elimination of water to form 2,4-dinitrophenylhydrazone. The DNPH-hydrazones, formed during sampling, are non-volatile and remain on the sampling medium, which is usually either a reagent-impregnated cartridge or an impinger charged with the reagent solution. The yellow to deep-orange colored DNPH-hydrazones have UV absorption maxima in the 360-375 nm range and can be analyzed by the high performance liquid chromatography (HPLC) method coupled with UV detection. This method offers very high selectivity and sensitivity of analysis. The analytical method is well established, and questions regarding the accuracy of the DNPH method are mainly concerned with sampling. The major concerns are: 1) incomplete collection of carbonyls, 2) loss of carbonyl compounds by physical processes such as adsorption or chemical reaction with copollutants such as ozone, 3) generation of carbonyl compounds as sampling artifacts, and 4) variable blanks resulting from contamination of the reagent and sampling equipment. Several recent review articles treat the subject of carbonyl compound sampling and analysis in detail (Vairavamurthy et al, 1993; and Zielinska and Fujita, 1995, Apel et al., 1998).

A carbonyl sampling system consists of a diaphragm pump capable of maintaining air flow through the cartridges of 500-1500 ml/min, flowmeter, six-port solenoid manifold allowing unattended collection of up to six carbonyl samples, needle valves for flow rate regulation, and check valves to protect cartridges from outside air when air is not being sampled through a given cartridge. For automatic operation, the timer starts and stops the pump at the appropriate time. The timer also opens the six-port solenoid valve when the pump starts and closes it when the pump stops. A charcoal filter is attached to the pump outlet in order to remove traces of acetonitrile from DNPH cartridges.

Carbonyl compounds collected in the cartridges (as hydrazones) are eluted with HPLC grade acetonitrile and analyzed by HPLC with UV detection at 360 nm. A reverse phase HPLC column is used. Identifications are made based on matching the HPLC retention times with those of authentic standards. A three-level calibration curve (plus blank) is constructed for each quantified hydrazone. The C_1-C_7 carbonyl compounds that can be quantified include formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, crotonaldehyde, methyl ethyl ketone, methacrolein, butyraldehyde, benzaldehyde, valeraldehyde, tolualdehyde, and hexanaldehyde.

2.3.3 C_8-C_{20} Hydrocarbons by Tenax Sampling and Analysis by GC/FID or GC/MS

Volatile organic compounds exhibit a wide range of volatility and are hence distributed in the atmosphere between the gas and particle phases. Hydrocarbons with vapor pressures less than n-undecane are not currently quantified in the PAMS program. Zielinska and Fujita (1994) found that semi-volatile hydrocarbons accounted for 7 to 15 percent of the C_{10} to C_{18} hydrocarbons in Los Angeles and about 16 percent of the total ozone forming potential of NMHC. It has been shown that hydrocarbons in the range of C_{10}-C_{20} are important components of the total hydrocarbons emitted from heavy-duty diesel vehicles.

Volatile hydrocarbons in the range of C_8-C_{20}, are usually collected using Tenax solid adsorbent. Prior to use, the Tenax solid adsorbent is cleaned by Soxhlet extraction with hexane/acetone mixture, packed into Pyrex glass tubes and thermally conditioned for four hours by heating at 300 °C under nitrogen purge. Approximately 10% of the precleaned Tenax cartridges are tested by GC/FID for purity prior to sampling. After sampling, the Tenax cartridges are capped tightly using clean Swagelok caps (brass) with graphite/vespel ferrules, and placed in metal containers with activated charcoal on the bottom. Tenax samples are usually analyzed by the thermal desorption-cryogenic preconcentration method, followed by quantification by high resolution gas chromatography with flame ionization detection (GC/FID) or mass spectrometric detection (GC/MSD) of individual hydrocarbons.

2.4 Data Validation

Data validation is a process of determining and denoting the quality of the data set. The validation process consists of evaluating the internal, spatial, temporal and physical consistency of data sets for invalid data or for outliers. During validation, physically unrealistic data are invalidated, biases and instrument drifts are noted, and gross errors are identified. The objective of the data validation process is to produce data of known quality. The following three levels of validation are applied which will result in the assignment to each measurement of one of the following ratings: 1) valid; 2) valid but suspect; or 3) invalid.

2.4.1 Level 0 Validation

Level 0 data consist of a reasonably complete data set of unspecified quality that has been subjected to minimum processing in the field and/or in the laboratory by project staff. Level 0 data have not been audited or reviewed. The data contain all available measurement data and quality control checks (e.g., media lot certification results, daily instrument calibration checks) and flags indicating missing or invalid data due to instrument or sampler malfunctions and sampling errors. These errors include sampling times and duration that are outside specifications and sampling conditions outside acceptable specification (e.g., insufficient canister pressure and insufficient or excessive flow rates).

2.4.2 Level 1 Validation

Indicates a complete date set of specified quality that has been subjected to quality assurance and quality control checks and data management procedures. Level 1 data validation normally takes place in the field or in the laboratory and consists of: 1) flagging samples when significant deviations from measurement assumptions have occurred; 2) verifying computer files against data sheets; 3) eliminating values for measurements which are known to be invalid because of instrument malfunctions; 4) adjustment of measurement values for blanks, zero drifts, and quantifiable calibration or interferences biases; 5) determining measurement precision by replicate analyses and by collection of file blanks and collocated samples. Level 1 also includes internal consistency checks. Species within the same data set are examined for expected correlations and time series and spatial patterns are examined to detect outlier, extreme values, or time periods with too little or too much variation.

Comparisons of co-pollutants are important validation checks for determined the overall accuracy and validity of the measurements. Species emitted from the same source type should correlate in the absence of other significant sources of these species, and exhibit average ratios of species that reflect the nature of the source or their relative persistence in the atmosphere. For example, hydrocarbons such as ethylene and acetylene are produced from combustion of hydrocarbon fuels in internal combustion engines. Figure 2-1 shows scatterplots of acetylene versus ethylene during the morning and afternoon sampling period at Azusa, California during the summer of 1995 and 1996. These two species show excellent correlation during the morning. The corresponding ethylene/acetylene ratios are lower in the afternoon samples. Also note that the mixing ratios in the afternoon sample are about half of the morning levels due to increased mixing heights.

Table 2-2 shows the relative emissions of ethylene and acetylene in vehicle exhaust from dynamometer and tunnel measurements over the past three decades. With the introduction of emission controls, ethylene and acetylene have both decreased as a fraction of total NMHC. However, the decrease for acetylene has been greater because the catalyst removes it more efficiently. Well-maintained catalyst-equipped vehicles have ethylene/acetylene ratios of three or greater based upon FTP emission tests (Hoekman, 1992; Sigsby et al., 1987), while non-catalyst vehicles have ethylene/acetylene ratios near one (Hoekman, 1992; Black, et al., 1980). Fuel-rich conditions (Siegl et al., 1992; McCabe et al., 1992) due to engine malfunction or "open-loop" operation during high acceleration and load can also produce lower ethylene/acetylene ratios relative to normal emitters under closed-loop operation. With the turnover of the vehicle fleet to newer emission control technologies, the fractions of total vehicle exhaust emissions that are contributed by vehicles with malfunctioning emission controls and fuel-rich driving conditions could increase. This is the most likely explanation for the changes in average ethylene/acetylene ratios in the SoCAB from 1.5 during the 1987 Southern California Air Quality Study (Fujita, et al., 1994) to1.8 and 0.9 for hydrocarbon samples collected in SoCAB during 1990 (Zielinska et al., 1992) and in 1995 (Fujita et al., 1997a), respectively.

2.4.3 Level 2 Validation

Level 2 validation indicates a complete, externally consistent data set of specified quality that consists of data that have undergone interpretative and diagnostic analysis by project staff or user community. Level 2 validations take place after the data from various measurements methods have been assembled in a master database. Level 2 applies consistency tests, based on known physical relationship among variables to the assemble data. These tests fall into three categories: detection of extreme values; consistency among co-pollutants and between redundant measurements buy alternative measurement methods.

Comparisons of redundant measurements by alternative methods are particularly useful in detecting systematic biases due to calibration errors. These comparisons include sums of species versus preconcentration direct injection with flame ionization detection (PDFID) or continuous NMHC analyzer (e.g. TEI 55) , automated gas chromatograph versus GC-FID analysis of canister sample, and analysis of Tenax cartridges versus canister samples for the C_8 to C_{11} hydrocarbons.

Examination of spatial and temporal distributions of atmospheric constituents and relative abundances of certain chemical species is a useful prelude to receptor modeling. When coupled with a conceptual understanding of the emissions sources, meteorology, and chemical transformation mechanism, this receptor-oriented analysis provides qualitative, and even semi-quantitative, evidence of relationships between source emission and receptor mixing ratios.

2.4.4 Level 3 Validation

Level 3 validations are part of the subsequent data interpretation process. Receptor modeling, factor and other statistical analysis, and photochemical air quality simulation models are several examples. Unusual values are identified during he data interpretation process as: 1) extreme values'; 2) values which would otherwise normally tract the values of the other variables in time series; sand 3) values for observables that would normally follow a qualitatively predictable spatial or temporal pattern.

2.5 External Performance Audits and Comparison Studies

Several laboratory intercomparisons have been conducted within the past decade for speciated volatile organic compounds. These include the International Hydrocarbon Intercomparison Experiment, organized by the National Center for Atmospheric Research (Apel et al., 1994) and comparison studies conducted as part of the quality assurance program for the Costal Oxidant Assessment for Southeast Texas (Fujita et al., 1995a), NARSTO-Northeast (Fujita et al., 1997b), and the 1997 Southern California Ozone Study-NARSTO (Fujita et al., 1999c; Fujita et al., 2003c). These comparison studies included PAMS VOC monitoring sites in the northeast, Texas, and Southern California. Agreements between most laboratories are generally within 10 percent for mixing ratios above 1 ppbC. Identification and quantification of the 55 PAMS target species are normally consistent among PAMS laboratories. However, there are greater variations for sums of NMHC and NMOC.

Table 2-1
PAMS Target Compounds

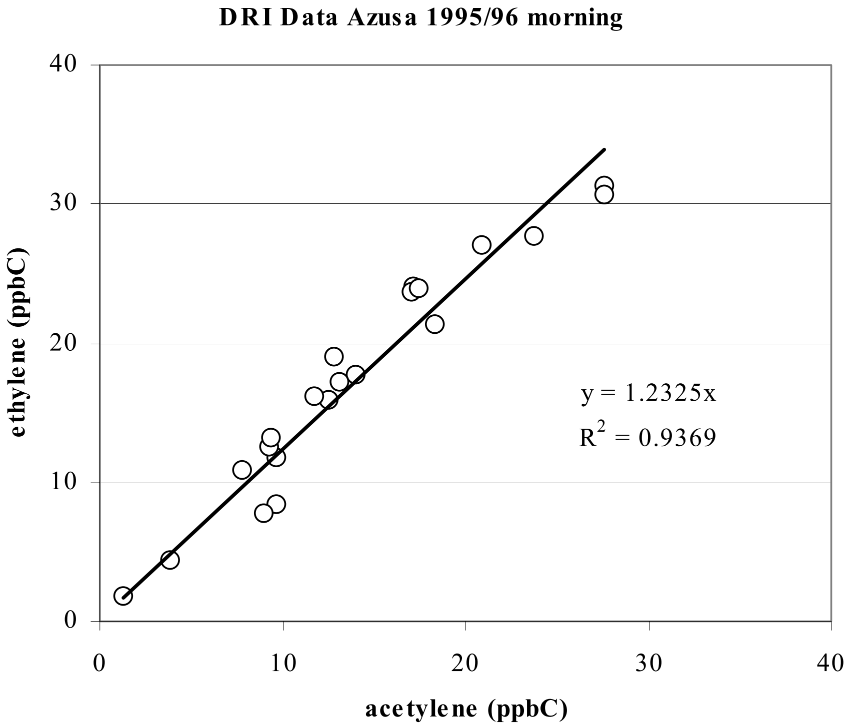
No.	Mnemonics	Names	AIRS Code	Formula	MW	Group	k_{OH} at 298 K	Lifetime hours
1	ethene	ethene	43203	C2H4	28.05	O	8.52	6.52
2	acetyl	acetylene	43206	C2H2	26.04	Y	0.90	61.73
3	ethane	ethane	43202	C2H6	30.07	P	0.27	207.30
4	prope	Propene	43205	C3H6	42.08	O	26.30	2.11
5	n_prop	n-propane	43204	C3H8	44.10	P	1.15	48.31
6	i_buta	isobutane	43214	C4H10	58.12	P	2.34	23.74
7	lbut1e	1-butene	43280	C4H8	56.11	O	31.40	1.77
8	n_buta	n-butane	43212	C4H10	58.12	P	2.54	21.87
9	t2bute	t-2-Butene	43216	C4H8	56.11	O	64.00	0.87
10	c2bute	c-2-butene	43217	C4H8	56.11	O	56.40	0.99
11	ipenta	isopentane	43221	C5H12	72.15	P	3.90	14.25
12	pente1	1-pentene	43224	C5H10	70.13	O	31.40	1.77
13	n_pent	n-pentane	43220	C5H12	72.15	P	3.94	14.10
14	i_pren	isoprene	43243	C5H8	68.11	O	101.00	0.55
15	t2pene	t-2-Pentene	43226	C5H10	70.13	O	67.00	0.83
16	c2pene	c-2-pentene	43227	C5H10	70.13	O	65.00	0.85
17	bu22dm	2,2-dimethylbutane	43244	C6H14	86.17	P	2.32	23.95
18	cpenta	cyclopentane	43242	C5H10	70.13	P	5.16	10.77
19	bu23dm	2,3-dimethylbutane	43284	C6H14	86.17	P	6.20	8.96
20	pena2m	2-methylpentane	43285	C6H14	86.17	P	5.60	9.92
21	pena3m	3-methylpentane	43230	C6H14	86.17	P	5.70	9.75
22	p1e2me	2-methyl-1-pentene	43246	C6H12	84.16	O	31.40	1.77
23	n_hex	n-hexane	43231	C6H14	86.17	P	5.61	9.90
24	mcypna	Methylcyclopentane	43262	C6H12	84.16	P	8.81	6.31
25	pen24m	2,4-dimethylpentane	43247	C7H16	100.20	P	5.10	10.89
26	benze	benzene	45201	C6H6	78.11	A	1.23	45.17
27	cyhexa	cyclohexane	43248	C6H12	84.16	P	7.49	7.42
28	hexa2m	2-methylhexane	43263	C7H16	98.19	P	6.79	8.18
29	pen23m	2,3-dimethylpentane	43291	C7H16	100.20	P	4.87	11.41
30	hexa3m	3-methylhexane	43249	C7H16	100.20	P	7.16	7.80
31	pa224m	2,2,4-trimethylpentane	43250	C8H18	114.23	P	3.68	15.10
32	n_hept	n-heptane	43232	C7H16	100.20	P	7.15	7.77
33	mecyhx	methylcyclohexane	43261	C7H14	98.19	P	10.40	5.34
34	pa234m	2,3,4-trimethylpentane	43252	C8H18	114.23	P	7.00	7.94
35	tolue	toluene	43202	C7H8	92.14	A	5.96	9.32
36	hep2me	2-methylheptane	43260	C8H18	114.23	P	8.18	6.80
37	hep3me	3-methylheptane	43253	C8H18	114.23	P	8.56	6.49
38	n_oct	n-octane	43233	C8H18	114.22	P	8.68	6.40
39	etbz	ethylbenzene	45203	C8H10	106.16	A	7.10	7.82
40	mp_xyl	mp-xylene	45109	C8H10	106.16	A	18.95	4.71
41	styr	styrene	45220	C8H8	104.14	A	58.00	0.96
42	o_xyl	o-xylene	45204	C8H10	106.17	A	13.70	4.06
43	n_non	n-nonane	43235	C9H20	128.26	P	10.20	5.45
44	iprbz	isopropylbenzene	45210	C9H12	120.20	A	6.50	8.55
45	n_prbz	n-propylbenzene	45209	C9H12	120.20	A	6.00	9.26
46	m_etol	m-ethyltoluene	45212	C9H12	120.20	A	19.20	2.89
47	p_etol	p-ethyltoluene	45213	C9H12	120.20	A	12.10	4.59
48	bz135m	1,3,5-trimethylbenzene	45207	C9H12	120.20	A	57.50	0.97
49	o_etol	o-ethyltoluene	45211	C9H12	120.20	A	12.30	4.52
50	bz124m	1,2,4-trimethylbenzene	45208	C9H12	120.20	A	32.50	1.71
51	n_dec	n-decane	43238	C10H22	142.29	P	11.60	4.79
52	bz123m	1,2,3-trimethylbenzene	45225	C9H12	120.20	A	32.70	1.70
53	detbz1	m-diethylbenzene	45218	C10H14	134.22	A	14.20	3.90
54	detbz2	p-diethylbenzene	45219	C10H14	134.22	A	14.20	3.90
55	n_unde	n-undecane	43954	C11H24	156.30	P	13.20	4.20

Note: Rate constants k at 298 K for the reaction of OH radicals with VOCs.

Unit: 10^{12} x k cm^3 molecule^{-1} s^{-1}

Table 2-2
Relative Emissions of Ethene and Ethyne in Vehicle Exhaust from Dynamometer and Tunnel Measurements

Study	Model Years	No. of cars	Ethene mg/mi	Ethyne mg/mi	NMHC g/mi	Ethene/ NMHC	Ethyne/ NMHC	Ethene/ Ethyne
FTP Composite								
Sigsby et al., 1987	1975	3	421.4	238.2	4.25	9.91%	5.60%	1.77
Black et al, 1980	1963	1	544.1	411.1	3.62	15.03%	11.36%	1.32
Sigsby et al., 1987	1977	4	258.0	221.1	3.06	8.44%	7.24%	1.17
Hoekman, 1992	1970-78	4	223.4	209.7	2.80	7.99%	7.50%	1.07
Sigsby et al., 1987	1978	5	301.0	80.5	2.74	10.99%	2.94%	3.74
Sigsby et al., 1987	1979	5	176.6	45.8	2.02	8.73%	2.26%	3.86
Sigsby et al., 1987	1976	4	217.3	44.7	1.93	11.25%	2.32%	4.86
Sigsby et al., 1987	1975-82	46	136.8	41.4	1.50	9.11%	2.76%	3.30
Sigsby et al., 1987	1980	7	131.3	26.8	1.16	11.33%	2.31%	4.90
Sigsby et al., 1987	1981	12	45.4	10.0	0.62	7.35%	1.62%	4.54
Stump et al., 1992a	1986-90	6	30.7	6.9	0.50	6.16%	1.39%	4.45
Hoekman, 1992	1976-82	5	47.6	15.4	0.45	10.58%	3.42%	3.10
Sigsby et al., 1987	1982	6	20.5	2.9	0.43	4.72%	0.66%	7.20
Gorse, 1992	1983-85	14	32.3	17.1	0.39	8.23%	4.36%	1.89
Stump et al., 1992b	1987-89	9	21.3	5.4	0.35	6.05%	1.53%	3.95
Stump et al., 1990	1985-87	11	21.7	9.2	0.34	6.34%	2.70%	2.35
Hoekman, 1992	1983-90	5	22.2	7.4	0.33	6.80%	2.26%	3.01
Hoekman, 1992	1986-89	5	19.5	2.8	0.30	6.47%	0.94%	6.87
Stump et al., 1989	1984-87	9	15.0	9.7	0.28	5.37%	3.49%	1.54
Gorse, 1992	1989	20	13.0	4.5	0.16	8.41%	2.89%	2.91
Tunnel Measurements	Tunnel	Year	ppbC	ppbC	ppmC			
Lonneman et al., 1986	Lincoln	1970	1375	1033	16.5	8.31%	6.24%	1.33
Lonneman et al., 1986	Lincoln	1982	409	161	4.2	9.67%	3.80%	2.54
Zielinska et al., 1992	Caldecott	1991	154	56	2.5	6.16%	2.24%	2.75



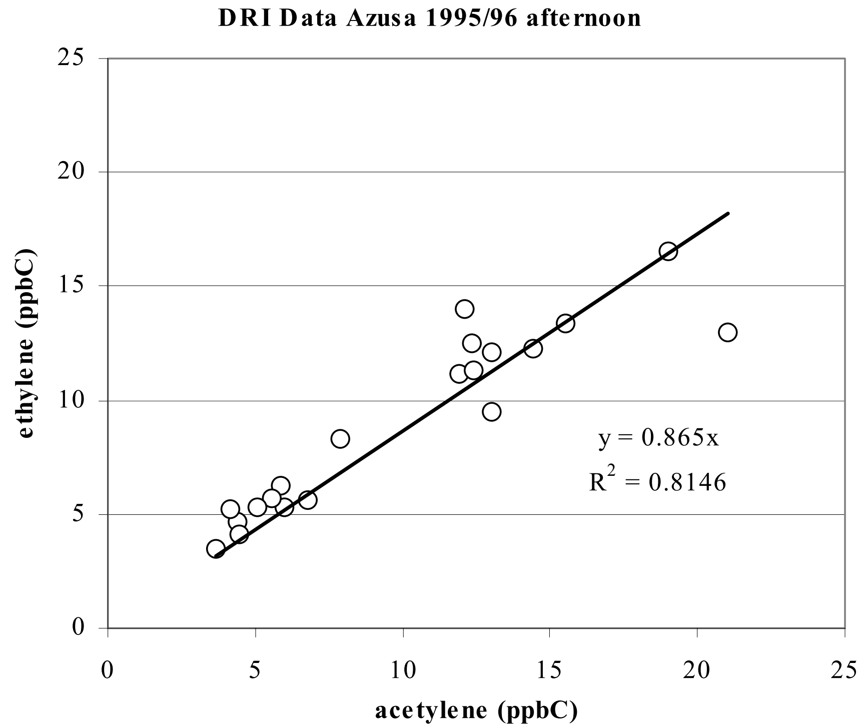


Figure 2-1. Scatterplot of ethylene versus acetylene for morning and afternoon samples at Azusa, California during the summers of 1995 and 1996.

3. SOURCE COMPOSITION PROFILES

This section describes the compilation, derivation, and evaluation of the source composition profiles suitable for apportioning ambient PAMS hydrocarbon data using CMB. The profiles are listed and described in Appendix B. The actual profiles are available electronically in the self-extracting compressed excel file CMBProfilesLibrary.exe. This library is a compilation of source profiles that have been used by the Desert Research Institute in prior VOC source apportionment studies. They include profiles that were obtained for specific studies, the literature, and from the California Air Resources Boards Modeling Emissions Data System (MEDS). Studies for which profiles were newly developed include the 1993 Coast Oxidant Assessment for Southeast Texas (Fujita et al., 1995b), 1995 Boston and Los Angeles VOC Source Apportionment Study (Fujita et al. 1997a), 1995/96 Washington Ozone Transport Study (Fujita et al., 1997c), 1996 El Paso/Juarez Ozone Study (Fujita, 2001; Seila et al., 2001), and 1998 Central Texas On-Road Hydrocarbon Study (1999a), 1999 VOC Source Signatures in Houston, TX (Fujita et al., 1999b), apportionment of 1994-97 South Coast Air Basin PAMS VOC data (Fujita and Campbell, 2003b), and the 2000 Weekend Ozone Observations in the South Coast Air Basin (Fujita et al. 2002; Fujita et al., 2003a). This CMBProfilesLibrary file is available through the EPA TTN web site at http://www.epa.gov/ttn/ and at the Desert Research Institute web site at http://www.dri.edu/People/ericf. The DRI Web site also provides general technical support and access to relevant papers and reference materials.

3.1 Source Composition Profile Normalization and Uncertainties

The profiles are expressed as volume percentages and are normalized to the sum of the 55 PAMS target hydrocarbons. The PAMS species typically account about 80 percent of the total ambient hydrocarbons in urban locations, and their sum is more reproducible among different laboratories than total NMHC or NMOC. Compounds other than the 55 Photochemical Assessment Monitoring Station (PAMS) target NMHCs that are individually identified are grouped into a category named “other”. Compounds reported as “unknowns” are grouped into a category named "UNID". The profiles also include total NMHC (i.e., the sum of PAMS species + other + unid) normalized to sum of PAMS species. Although not measured in the PAMS program, methyl tert-butyl ether (MTBE) is included in the profiles because it is a major component in reformulated gasoline and in the exhaust of vehicles using RFG. By including MTBE in the profile, its ambient concentration can be predicted by CMB.

Each profile has values for all 55 PAMS species, additional species used for CMB modeling, several composite species, plus CO and NOx (105 species total). A list of the species with full names and other relevant information is included in Appendix A. Except for CO and NOx, which are tabulated as concentration in ppm or ppb, respectively, values are the weight fraction of each species normalized to the sum of the 55 PAMS species. Profiles where PAMS species accounted for <5% of total are not included. The source profile data reported in units of ppbC were converted to $\mu g/m^3$ prior to calculating the weight percentages using species-specific conversion factors. One-sigma uncertainties were derived from variations among multiple measurements for a particular source type or a analytical uncertainty estimated by SQRT(0.1*W^2+0.002^2), where W is the normalized weight fraction of a species, 0.1 is the nominal analytical precision, and 0.002 is the minimum uncertainty. Most profiles do not contain concentrations for all of the species listed. Missing species are given the weight fraction 0.00001 with uncertainty equal to 0.002. Zero values in the original profiles are included as zero with uncertainty equal to 0.002.

3.2 Review and Preparation of Source Profile CMB Input File Using the Source Profile Library

A catalog of source profiles is contained in the Excel file, CMBProfilesLibrary.xls. The source composition data are contained in the worksheet 'profiles table', which is linked to several other worksheets that create the source composition input file and several optional input files (see Section 4 for details on the optional input files). A list of all species included with full names and other useful information are included in the worksheet 'CMB_species'. Type the 'INDEX#' for the profiles in one or more of the four green boxes at the top of the sheet to graphically compare up to four profiles (**only those cells that are shaded green should be edited**). Switch to worksheet 'charts' (CTRL+PageDown) to see column plots of the profiles. The upper plot contains the 55 PAMS species, the lower plot all other organic species. Note that the profiles are plotted on a log scale and the uncertainties are not indicated. A third plot below shows a detailed comparison of the typical major species for the first two profiles selected.

To assist with the selection of profiles, several sort fields have been included such as category (source type), location and year. The list of profiles can be filtered by selecting values from any or all of these fields using the pull down menus on each heading (click the arrow in small grey box). For example, one might select 'gasoline exhaust' in the Category column, 'greater than 1996' (using the custom option) in the Year column, and 'SCAB' in the Location column to view only those profiles applicable to on-road automobile emissions in the South Coast Air Basin. Filtering the list has no effect on the charts displayed. Sorts can also be performed on the table as long as all columns are sorted together. A few notes on using the pull-down filters: the current cell selection does not change when filters are set, so it may be necessary to scroll up or down to see the results of a filter. Also, filters are sequential so each selection may limit your choices on subsequent filters. Make sure all filters are reset to (All) before starting a new selection. When a filter is on, the small arrow on the column heading turns blue. If a sort is performed while filters are on, only those data displayed will be sorted.

To create source composition profile input files for CMB8, select all profiles to be included in the source selection file by flagging them in the worksheet 'profiles table' with any character in the column labeled Select. You may view a filtered list of profiles by selecting filtering criteria from any of the pull-down menus at the top of each column. If you wish to clear out any previous selections, make sure all profile records are displayed by selecting 'all' in the pull-down autofilter menus for each column, then clear all values in that column. Once you have selected all profiles desired switch to worksheet 'defaultSources'. Here you can pre-select up to 10 combinations of source profiles to use in the CMB8 fitting process. Once you have saved the worksheet, close it and change the file extension to .sel so that CMB8 will recognize it. A default species selection file can also be generated by editing the green cells in sheet 'defaultSpecies' before creating the species selection file. A macro is provided to create the source profile input file along with the other optional CMB input files (see Section 4). To run the macro press CTRL-m.

3.3 Source Composition Profile Categories

The receptor modeling approach requires accurate and precise measurements of the chemical composition of emission sources and ambient receptor concentrations. Moreover, the source profiles must be representative of the study area during the period when the ambient data were collected. The emissions inventory is the starting point to identify potential contributors to ambient concentrations. Vehicle-related emissions (exhaust, liquid fuel and evaporated fuel) are ubiquitous in all urban areas and are always included. Architectural coatings (i.e., paints) and industrial solvents (i.e., cleaning and process solvents, as in printing) are also common, but highly variable spatially. Petrochemical production and oil refining are more specific to certain urban settings, such as the Texas coast, where these activities are numerous. Biogenic emissions are generally larger in the eastern U.S., where forests are lush in contrast to the arid west.

3.3.1 Vehicle Exhaust

Despite sharp reductions in VOC emission rates of new production vehicles in the U.S., on-road motor vehicles remain the largest source of VOC emissions in urban areas. This category consists of gasoline-powered and diesel-powered passenger cars, light-duty trucks (6,000 lbs. gross vehicle weight [GVW] or less), medium-duty trucks (6,001-8,500 lbs. GVW), heavy-duty trucks (over 8,500 lbs. GVW), urban buses, and motorcycles. VOC emissions from motor vehicles consist of tailpipe exhaust and evaporative (hot soaks, diurnals, running loss, and resting loss) emissions. Composites of dynamometer measurements of vehicles of varying age and mileage or on-road measurements (e.g., tunnels and roadways) are commonly used to represent fleet-averaged exhaust profiles. Profiles based on dynamometer tests should include a weighted sum of exhaust profiles for noncatalyst vehicles, high-emitting vehicles and catalyst-equipped vehicles with site-specific weighting factors to approximate the fleet-averaged exhaust composition. The fuels used in the dynamometer tests should resemble the fuels used in the study region at the time the ambient samples are collected. On-road measurements are usually preferred in CMB applications because they include a composite of the exhaust from many vehicles that more closely represents the local vehicle population than dynamometer tests of a small sample of vehicles. However, tunnel measurements also include varying amounts of diesel exhaust and running evaporative losses.

Cold start exhaust emissions occur from the time the engine starts, after being off for one or more hours for a catalyst-equipped vehicle and four or more hours for a non-catalyst-equipped vehicle, until the coolant achieves its nominal operating temperature. Cold start emissions are incremental emissions that are added to running exhaust emissions. Running exhaust includes emissions from the tailpipe or through the crankcase after the vehicle is warmed up and in a stabilized mode. Exhaust emission rates are determined from dynamometer tests using the Federal Test Procedures (FTP). The FTP tests are used for certification of new vehicles and to check compliance over a period of time. For cars and light-duty trucks the FTP driving schedule consists of three driving/sampling phases or "bags." Bag 1 is a 505-second 3.6-mile drive from cold start. Bag 2 is the following 867 seconds and 3.9 miles. Bag 3 follows after a 10-minute shutdown and is the same as Bag 1 except that it begins from a hot-start condition. Total driving time is 31.3 minutes, 11.1 miles, average speed of 21.3 mi/hr, peak speed of 56.7 mi/hr: 17.9%

of the engine running time is spent at idle. The exhaust measurements utilize dilution with air to a constant and known volumetric flow rate by means of a Constant Volume Sampler (CVS).

Vehicle Exhaust Profiles Derived from Dynamometer Tests

The gasoline-powered vehicle exhaust profile, Exh801, was derived from the Federal Test Procedure (FTP) tests of Sigsby et al. (1987) which involved 46 in-use passenger vehicles for 1975 to 1982 model years. Profile Exh801 was re-calculated by the ARB from the EPA's original measurements to provide a more complete chemical break-down. Propane/propene, benzene/cyclohexane, and toluene/2,3-dimethylhexane were not separately reported by Sigsby et al., so ratios of 3:1, 1:1 and 9:1 were assumed by the ARB for these pairs of species, respectively. However, motor vehicle exhaust profiles measured in the Caldecott Tunnel by Zielinska et al. (1992) and in FTP dynamometer tests by Stump et al. (1989, 1990), Hoekman (1992), Burns et al. (1991) and Chock and Winkler (1992) were inconsistent with the abundances in Exh801 when the foregoing ARB ratios are used. Propane/propene, benzene/cyclohexane, and toluene/2,3-dimethylhexane ratios of 3:22, 19:1 and 1:0 were consistent with those found by Zielinska and Fung (1992) were applied to obtain profile Exh801a (Fujita et al., 1994).

Exhaust profiles were similarly developed for the Auto-Oil Program. ACCS, ACST, and ACHS are averages for incremental cold start, stabilized and hot start emissions profiles for the "current" vehicle fleet (1989) using industry average gasoline (Fuel A, based on the 1988 Motor Vehicle Manufacturers Association [MVMA] summer nationwide fuel survey). AOCS, AOST, and AOHS are the corresponding profiles for the Auto/Oil "older" fleet (1983 to 1985) using Fuel A (Burns et al., 1991, Chock et al., 1992). ACCOMP and AOCOMP are the FTP composite profiles for current and older fleets, respectively. EXHCOMP2 is a composite of AOCOMP with two on-road vehicle exhaust profiles, TU_MCHLD and SOS. This composite profile was used by Fujita et al. (1995a) to apportion the hydrocarbon data for the 1993 Coastal Oxidant Assessment for Southeast Texas (COAST) Study.

The exhaust compositions were determined for 141 light-duty gasoline-powered vehicles during the 1995 Orange County High Emitter Study (Lawson et al. 1996). The vehicles were initially identified as high emitters by on-road remote sensing. The vehicles were tested given IM-240 tests prior to and after repair. The chemical composition of the exhaust was determined for both cases. Based upon these results, composite profiles were derived for varying fraction of high-emitters in the composite in 10 percent increments.

Vehicle Exhaust Profiles Derived from Measurements in Highway Tunnels

On-road vehicle exhaust profiles were derived from measurements by the Desert Research Institute (DRI) in the Caldecott Tunnel in the San Francisco Bay Area (Zielinska et al., 1992), Tuscarora Tunnel in Pennsylvania, and Fort McHenry Tunnel in Baltimore (Sagebiel et al., 1996) and by roadside measurement made by the U. S. Environmental Protection Agency during the Atlanta Study as part of the Southern Oxidant Study (SOSROAD, Conner et al., 1995). The Fort McHenry Tunnel is an underwater tunnel with upgrade and downgrade segments. Separate profiles were developed for each segment and a composite profile for the entire tunnel. A diesel exhaust profile was developed by DRI (Sagebiel et al., 1996) from the Ft.

McHenry Tunnel by extrapolating the regressions of species weight fraction as a function of the relative fractions of light-duty gasoline versus heavy-duty diesel traffic. Investigators from DRI also conducted a series of experiments in 1995 to quantify emission rates of carbon monoxide (CO), nitrogen oxides (NOx), and speciated nonmethane hydrocarbons (NMHC) from in-use vehicles at the Lincoln Tunnel in New York (August 16-18) and at the Callahan Tunnel in Boston, MA (September 18-19) (Gertler et al., 1997). Similar experiments were conducted during the same year at the Deck Park Tunnel in Phoenix, AZ (January 24-26 and again in July 25-27), and at the Van Nuys Tunnel (June 8-12) and Sepulveda Tunnel (October 3-4) in the Los Angeles area. The sampling protocol and characteristics of the vehicle traffic for each of the tunnel measurements are described by Gertler et al. (1997). The on-road vehicle exhaust profiles represent primarily hot stabilized exhaust emissions but also include evaporative emissions from running and resting losses.

Composite spark-ignition vehicle exhaust profiles were derived by Fujita et al. (1997a) from the DRI tunnel measurements by subtracting the contributions of diesel exhaust and running evaporative losses from each tunnel sample. First, the diesel exhaust was subtracted from the tunnel measurement by fitting a diesel exhaust profile to the tunnel samples using only decane and undecane as fitting species. These two species were used because they are enriched in diesel exhaust relative to gasoline exhaust and minimize the overestimation of the diesel contribution that would result if species common to both sources are used to determine the solution. The resulting diesel contributions to total nonmethane hydrocarbons (C_2 to C_{11}) range from 3 to 9 percent, which are consistent with the observed fractions of diesel traffic.

The method described above cannot be used to remove the contributions of evaporative emissions because there are no species that exist in gasoline that does not also exist in tailpipe emissions. Instead, varying contributions of evaporative emissions were subtracted from each tunnel sample in five- percent increments from 0 to 50 percent. CMB was applied to the ten alternative diesel and evaporative emissions-corrected samples for each tunnel run with diesel exhaust and evaporative emissions as source profile. The model performance parameters and comparisons of calculated and measured amounts of total NMHC, isobutane, n-butane, and isopentane were examined to determine the level of evaporative corrections that yield the best fit. The fit deteriorates rapidly beyond a certain level of assumed headspace vapor contribution of about 15 to 25 percent. The predicted vapor contributions do not increase above these levels of assumed vapor contribution. This is consistent with expectation since there is a limit to the fractional contribution of running losses to hydrocarbons mixing ratios in roadway tunnels. The profile library lists composites for the uncorrected tunnel measurements for the Callahan Tunnel (Tu_Cal), Lincoln Tunnel (Tu_Lin), Sepulveda Tunnel (Tu_Sep), and Van Nuys Tunnel (Tu_Van). Because the performance parameters for various levels of assumed headspace vapor contributions are similar up to the level at which the fit deteriorates, three sets of corrected profiles were derived for each tunnel run. One profile corresponding to no evaporative correction, or only diesel correction (Suffix of 0 attached to the uncorrected tunnel profile), and a second set of profiles that corresponds to the maximum level of evaporative correction before the fit begins to deteriorate (15-20%) (Suffix of 2). The third profile corresponds to an average between no correction and maximum correction (5-10%) (Suffix of 1). Similar profiles were also developed from measurements in the Mt. Baker, I-90 tunnel in Seattle, WA (Fujita et al. 1997c).

Vehicle Exhaust Profiles Derived from On-Road Measurements

On-road measurements were made in Houston during the 1993 COAST (Fujita et al., 1996) and in Juarez during the 1996 Paso del Norte (Fujita, 2001; Seila et al., 2001) Studies. Measurements involved sampling upwind and downwind of roadways or in heavily traveled intersections. The COAST samples included upwind/downwind hot soak and cold start samples collected at the Astrodome during and immediately after a ballgame, respectively, and up upwind/downwind samples along Westheimer Road, a secondary urban road in a residential area of Houston. Samples were also collected from the Baytown Tunnel, a roadway tunnel under the Houston Ship Channel. Samples were collected in Juarez near a heavily traveled intersection during rush hour and behind a propane bus in order to obtain approximate source composition profiles for "vehicle exhaust" and a propane-powered bus, respectively. The similarity between the two profiles for species greater than four carbons show that the propane bus exhaust samples contain varying amounts of exhaust from other vehicles. The average ratios between the two profiles for these larger hydrocarbons were used to subtract the contributions of the Juarez traffic from the propane bus profile.

As part of the 1998 Central Texas On-Road Hydrocarbon Study (Fujita et al. 1999a), DRI collected on-road samples on freeways and surface streets and at a truck stop in the Austin Texas area. Samples of vehicle exhaust were intended to represent four combinations of traffic and vehicle fleet characteristics: 1) free-flowing freeway, 2) congested freeway, 3) major surface arterial, and 4) heavy-duty diesel truck exhaust. Each of the freeway samples were collected over one hour during a series of traverses along a 6-mile stretch of I-35 from the southern edge of the Austin city limits at Slaughter Lane to a half mile south of the Colorado River at Woodland Avenue. Samples corresponding to congested traffic (CTMVFL01 and CTMVFL02) were collected between 0630 and 0830, and free-flowing freeway samples (CTMVFH01, CTMVFH02, and CTMVFH03) were collected between 0830 and 1100. Four 1-hour composite samples were collected along four different surface street loops of 4 to 5 mile in south Austin (CTMVSR01), downtown Austin (CTMVSR02), Oakhills area (CTMVSR03) and Williamson Creek area (CTMVST04). The four surface street loops represent the range of traffic patterns and fleet age distributions in the metropolitan Austin area. All ambient samples and motor vehicle source samples included canisters for C_2 to C_{11} hydrocarbons, Tenax cartridges for C_8 to C_{18} hydrocarbons in order to enhance the resolution in apportionment of diesel versus gasoline exhaust, and DNPH cartridges for C_1 to C_{11} carbonyl compounds.

Two sets of composite profiles were constructed for on-road SI vehicle emissions. The contributions of diesel exhaust and regional background were removed from each of the individual samples prior to forming the composite profiles. The regional background was removed by subtracting the average VOC composition at San Marcos for the morning on-road samples and the average VOC composition at McKinney Falls State Park for the midday and afternoon on-road samples. The total VOC concentrations of the on-road samples were typically an order of magnitude greater than the background concentrations. Diesel exhaust was removed by determining by CMB the contribution of the diesel exhaust (using the Fort McHenry Tunnel profile) in the background-subtracted on-road samples using only C_{12} to C_{16} n-alkane as fitting species. The two sets of composition profiles correspond to a combination of congested freeway traffic and morning surface street traffic in downtown Austin, and a combination of free-flowing freeway traffic and afternoon surface street traffic from three locations in south Austin. The former was used to fit morning ambient samples and the latter was used to fit afternoon and evening ambient samples.

Urban vehicle exhaust samples were also collected during summer 1999 in Houston, Texas (Fujita et al., 2001). Samples were collected over 50-minute sampling periods during series of traverses along a 4-mile stretch of the State Route 288 from Bellfort Street to Almeda Genoa Road (HOMV01 and HOMV02), surface streets in downtown Houston (HOMV03) and Westheimer Road from the 610 Freeway to Gessner (HOMV06), along the southwest section of the I-610 beltway (610, 59 E, and 45 S; HOMV04), and northwest section of the I-610 beltway (288 N, 59 W, 610 N, 10 E, 288 S, and 610 E; HOMV05) (Fujita et a., 2001). Background samples were collected a few miles south of the junction of SR 288 and the State Highway 8 beltway at the southwest corner of the Pearland Exit off SR 288. Background samples were collected once in the morning prior (0510 to 0610, CDT) to the commute period (HOMVB1) and once midday (1100-1200, CDT) (HOMVB2). The background sample HOMVB1 was subtracted from HOMV01 and HOMV02, the average of the two background samples were subtracted from HOMV03 and HOMV04, and HOMVB2 was subtracted from HOMV05, and HOMV06. Because the background samples contained unusually high concentrations due to a local source, toluene was corrected to average ratio of toluene to isopentane in liquid gasoline. This profile contains an undetermined, but presumably a representative mixture of both gasoline and diesel vehicle exhaust. Three 50-minute composite samples (HOMVD01, HOMVD02, and HOMVD03) were collected at an underpass beneath State Highway 146 at the intersection of N. Broadway and E. Barbour Cut Blvd near the Barbour Cut Terminal at the Barbour Cut Ship Channel. In addition to the three ambient samples with high contributions of diesel exhaust, two background samples were collected upwind of the terminal along the shores of Galveston Bay at the end of Ballester (Figure 2.1-4). Background samples were collected prior to (HOMVDB1) and after (HOMVDB2) after the three "diesel" samples. Heavy-duty diesel trucks accounted for about 75 percent of the traffic in the lane closest to the sampling van. The background sample HOMVDB1 was subtracted from HOMVD01 and HOMVDB2 was subtracted from HOMVD02, and HOMVD03.

The profiles for vehicle exhaust, liquid gasoline, and evaporated gasoline include many of the same species but exhibit notable differences. With only the light hydrocarbons measured, the heavy-duty diesel and light-duty gasoline exhaust profiles are similar, and are often collinear in CMB calculations. Ethene, acetylene, 1-butene, iso-butene, propane, propene, isopentane, n-pentane, 2,2 dimethylbutane, 2-methylpentane, n-hexane, benzene, 3-methyhexane, toluene, ethylbenzene, m- & p-xylene, m-ethyltoluene, and 1,2,4-trimethylbenzene, are the most abundant compounds in either or both of these emissions. Several of these are short-lived, as shown in Table 2-1, and are only used in CMB calculations where fresh emissions are expected, as during early morning. Major differences between these two exhaust profiles are evident for: 1) acetylene, iso-butene, isopentane, n-hexane, and 2-methylhexane, which are most abundant in gasoline exhaust; and 2) for propene, propane, 2,2 dimethylbutane, n-decane, and n-undecane which are more abundant in diesel exhaust. Previous studies showed that source attributions between tailpipe and evaporative emissions from receptor modeling can vary greatly depending on the particular profile chosen for tailpipe emissions (Harley et al., 1992, Fujita et al., 1994, Pierson et al., 1996). This is because tailpipe emissions are a mixture of hydrocarbons produced during combustion (e.g., acetylene, ethene, propene, and benzene) along with unburned gasoline resulting from incomplete combustion. The relative abundances of combustion by-products in the exhaust profile vary with emission control technology, level of vehicle maintenance and operating mode. In the CMB calculation, liquid gasoline represents the additional unburned gasoline (due to misfiring and other engine malfunctions) that is not included in the exhaust profile, plus evaporative emissions from gasoline spillage, hot soaks, and some portion of resting losses (leaks, permeation). The profile for gasoline headspace vapor is taken to represent fuel tank vapor losses (e.g., migration of fuel vapor from the canister).

3.3.2 Cold-Start Emissions

Samples were collected by DRI in the parking garage of the T. P. O'Neill Federal Building in downtown Boston on September 12-13, 1995 in order to obtain a composition profile for cold-start emissions (Fujita et al., 1997a). This garage is ideal in that there is very little traffic during the day and most vehicles leave the garage about the same time at the end of the workday. The ventilation exhaust fan, which normally runs in the afternoon from 2 to 5 p.m., reduces concentrations of VOCs in the garage to near street level prior to and during the time the vehicles leave. To ensure measurable differences between the cold-start and background samples, the ventilation period was rescheduled to run one hour earlier during our study (1 to 4 p.m.). One-hour canister samples were collected during the ventilation period ("background") and near the end of the workday at three locations within the garage on September 12 and again on September 13. The samplers were located between the garage exit and the ventilation fan about equal distance from each other at the end of a row of parking spaces nearest to the main exit aisle. On the first day of sampling, background and “cold start” samples (cold start plus background) were collected between 2:00-3:00 p.m. and 4:00-5:00 p.m., respectively. Twenty-nine vehicles entered or left the garage during the background-sampling period versus 56 vehicles that left during the cold-start sampling period. Two of the 56 vehicles were VW diesels. Background samples were collected on the second day between 1:15 and 2:15 p.m. and cold start samples were collected between 4:20 and 5:20 p.m. Twenty-eight vehicles entered or left during the background-sampling period and 53 vehicles (including one diesel vehicle) left during the cold-start sampling period. The differences in mixing ratios between the cold start and background samples were substantially higher during the second day. These measurements were used to derive a source composition profile for cold-start emissions.

3.3.3 Gasoline Liquid and Vapor

The reformulation of gasoline has significantly effected the composition of motor-vehicle related emissions in recent years. Both the federal government and the State of California have developed specifications for reformulated gasoline (RFG). The federal program is required for all severe and extreme ozone nonattainment areas, whereas the California program applies throughout the state. Both California and federal RFGs were introduced in two phases. California Phase 1 was introduced in 1992 and Phase 2 was introduction in 1996. Phases I of the federal program was introduced in 1995 and Phase II in 2000.

California Phase 1 gasoline had reduced RVP (Reid vapor pressure) in summertime and 2% oxygen (about 11% methyl-tert-butyl ether) in winter. Average specifications for federal

Phase I gasoline include RVP of 7.1 psi, 2.0% by weight oxygen content, and 1.0% by weight benzene content. These requirements were effective as of January 1, 1995 in nine major metropolitan areas of the United States with the worst ozone air pollution. The RFG program is federally implemented year-round in these areas as an emission reduction program to control ozone and air toxic emissions. Methyl tertiary butyl ether (MTBE) is the most common oxygenate used in reformulated gasoline. Tertiary amyl methyl ether (TAME), ethyl tertiary butyl ether (ETBE), and ethanol are found in a small percentage of reformulated fuels. The phase-out of MTBE in California, which was scheduled for December 31, 2002, has been postponed for one year.

The California Phase 2 RFG specifications apply to all gasoline sold in California beginning January 1, 1996, and include a maximum 80 ppmw sulfur content (average of 30 ppmw), a maximum 1.2% benzene content by volume (average of 0.8), a maximum 10.0% olefin content, a maximum 2.7% oxygen content by volume, a maximum T90 and T50 of 330 °F and 220 °F, respectively, maximum 30% aromatic hydrocarbon content by volume (average of 20%), and a maximum RVP of 7.0 psi. Investigations of the effects of RFG on automotive emissions have been conducted through the Auto/Oil Air Quality Improvement Research Program (AQIRP), by EPA, ARB, and individual oil companies. Results of the Auto/Oil AQIRP are illustrative of the general response of automotive emissions to changes in fuel parameters.

Compositional differences of vehicle exhaust from Transitional Low Emission Vehicles (TLEVs) operating on conventional industry-average gasoline (RF-A) versus California Phase 2 RFG were summarized by the ARB (1993). The summary includes data from testing programs conducted by the ARB, the Auto/Oil AQIRP, and Chevron Research & Technology Company. The motor vehicle test data were renormalized in terms of weight fractions, and the weight fractions for each species for all tests on an individual vehicle were averaged. The composite profiles for each vehicle were averaged to create composite profiles for each fuel. Separate composite profiles were calculated for each bag of the U.S. EPA 1975 Federal Test Procedure (FTP). For the composite FTP, the average weight fraction of n-alkanes decreased from 15.3% with RF-A to 8.5% with RFG, while the branched alkanes increased from 24.5% with RF-A to 35.8% with RFG. The relative abundances of cycloalkanes and alkynes remained unchanged, while olefins and oxygenates showed slight increases with RFG. Emissions of aromatic compounds decreased from 35.2% with RF-A to 27.7% with RFG. Differences are higher for specific compounds (e.g., benzene and MTBE). These compounds or their ratios serve as useful tracers for RFG.

There are several sources of evaporative emissions. Hot soak evaporative emissions result from gasoline vaporization from elevated engine and temperatures after the engine is turned off at the end of a trip. They can be from the region of the carburetor in carbureted vehicles in addition to residual pressure and heat input into the fuel system. Diurnal evaporative emissions result from expansion of the air-fuel mixture in a partially filled fuel tank due to diurnal changes in ambient temperature. The currently prescribed test is a 72-hour SHED test of three 24-hour cycles with diurnal minima and maxima of 72 ^{o}F and 96 ^{o}F, respectively. Running and resting losses are the two sources of evaporative loss from vehicles traveling on the road. Running losses are releases of gasoline vapor from the fuel system during vehicle operation as a result of the heating of the fuel tank. Vapors are released when the rate of fuel vapor formation exceeds the capacity of the vapor storage and purge systems. The composition of running losses tend to resemble headspace vapors if the canister is saturated, and butane-enriched vapors if the canister is not saturated. The canister similarly affects the composition of diurnal evaporative emissions. Resting loss evaporative emissions are due to migration of fuel vapors from the evaporative canister, from leaks, and from fuel permeation through joints, seals, and polymeric components of the fuel system. Most of these losses tend to appear more like whole liquid gasoline. Hot soaks also resemble liquid gasoline.

Liquid gasoline contains many compounds in common with gasoline-vehicle exhaust. It is depleted in products of combustion such as ethane, ethene, acetylene, propene, and to some extent, benzene. Evaporated gasoline is also depleted in these combustion compounds, as well as heavier hydrocarbons that volatilize more slowly from liquid fuels. Isobutane, n-butane, t-2 butene, and especially isopentane are enriched in evaporated gasoline. MTBE and it thermal decomposition product, isobutylene, stands out as a large constituent of gasoline exhaust emissions that clearly separates these from diesel in areas where it is used as an additive. These differences are sufficient for CMB separation of gasoline exhaust from liquid and evaporated gasoline, and often from diesel exhaust, in ambient air. The following gasoline samples have been analyzed and used in source apportionment studies.

Composite liquid and headspace vapor profiles consisting of averages of different brands and grades of gasoline were developed in conjunction with the Tuscarora, Fort McHenry, and SOS on-road exhaust experiments and for the Auto-Oil program. Profiles AODiurn, AOHSoak, and AORunLs are average diurnal, hot soak, and running loss emissions, respectively, for the Auto/Oil "older" fleet.

Twenty-one sets of bulk and headspace vapor chemical analyses were preformed by Environmental Analytical Services (EAS) as part of COAST for gasoline and diesel fuels sold in the Houston area comprising different grades and brands (Texaco, Chevron, Exxon, Diamond Shamrock, Shell and Conoco) of fuel.

Samples of various brands and grades of gasoline were collected during the Paso del Norte study and analyzed by Consolidated Sciences, Inc. Both unleaded regular "Magna Sin" and premium grades of gasoline were collected from two different service stations in Juarez. In El Paso, regular, mid, and premium grades of gasoline were collected from four brands of gasoline (Exxon, Chevron, Circle K, and Diamond Shamrock). Three alternative composite profiles were derived for Mexican gasoline based on a weighting of regular and premium grades of 50/50 (ME50R50P), 67/33 (ME67R33P), and 75/25 (ME75R25P). The composite for the gasoline sold in El Paso (US681220) is based on a study conducted by the American Petroleum Institute, which found that regular, mid-grade, and premium grades account for 68 12, and 20 percent of U.S. gasoline sales (API, 1996). Because headspace vapors were not analyzed in the study, the vapor profiles obtained by Mugica et al (1997) were used in the apportionment. These profiles are for leaded and unleaded gasoline from Mexico City.

Composite liquid and headspace vapor profiles consisting of an average of different brands and grades of gasoline were derived in conjunction with the 1995 on-road emissions and receptor modeling studies in the northeastern U. S. and the Los Angeles area (Fujita et al., 1997a). Ten gasoline samples were collected by DRI in the Boston area and were analyzed at the University of California, Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) under a subcontract to DRI. DRI analyzed the headspace vapor composition for these samples. In addition, sixty liquid gasoline samples (collected from the Los Angeles area during summer of 1995) were analyzed by CE-CERT for a separate study sponsored by the South Coast Air Quality Management District. The headspace vapors for a subset of these gasoline samples were analyzed by DRI as part of a study sponsored by the California Air Resources Board of the effect of California Phase 2 reformulated gasoline (Zielinska et al., 1997). Leakage of some of the gasoline samples from Boston raised concerns about the integrity of the remaining gasoline samples, particularly in regard to the relative amounts of light hydrocarbons that tend to be more abundant in samples of gasoline headspace. The Los Angeles gasoline profiles were used for all of the tunnel profile corrections and in the previous source apportionment study by Fujita et al. (1997a). The survey of motor gasolines conducted by the National Institute of Petroleum and Energy Research (NIPER) for summer 1995 (Dickson and Sturm, 1996) show how RFGs sold in southern California differ from those sold in the Northeast. The average volume percents of saturates, olefins, total aromatics, and benzene in unleaded RFG in the Northeast are 55.1, 11.0, 23.1, and 0.67 respectively, versus 53.1, 8.6, 27.1, and 0.79, respectively, in southern California. The average RVP is 7.9 in the northeast and 7.2 in southern California. The average volume percent of MTBE is 9.8 and 10.7 percent in the northeast and southern California, respectively. The average RVP is the most significant difference between RFGs that were sold in 1995 in the northeastern U.S. versus southern California. These differences affect the amounts and composition of evaporative emissions.

Investigators from DRI analyzed fifteen samples consisting of five brands (ARCO, BP, Chevron, Texaco, and Unocal) and three grades (regular, midgrade, and premium) of gasolines sold the Seattle area as part of a hydrocarbon source apportionment study for western Washington (Fujita et al., 1997c). The liquid and headspace compositions were determined by gas chromatography at DRI. The five brands of gasoline represent ~ 92 to 95 percent of the total sales in western Washington (Fogelquist, 1997). A study conducted by the American Petroleum Institute found that premium, mid-grade, and regular grades account for 20, 12 and 68 percent of gasoline sales (API, 1996). The average volume percent of saturates, olefins, total aromatics, and benzene in unleaded gasoline sold in the Pacific Northwest in 1996 were 56.3, 10.6, 33.0, and 2.37 percent, respectively (Dickson and Sturm, 1997). The average vapor pressure at 100 ^{o}F was 7.9 psi, which is similar to the RFG sold in 1995 in the northeastern U.S. In contrast gasoline sold in southern California during the same period had an average vapor pressure of 7.0 psi (Dickson and Sturm, 1997).

Gasoline samples (CTGASLnn) consisting of three grades (regular, mid, and premium) for three brands (Diamond Shamrock, EXXON, and Texaco) were analyzed by DRI for the 1998 Central Texas On-Road Hydrocarbon Study (Fujita, et al. 1999a). In addition to profiles for individual samples, composites were derived for each grade of gasoline from a combination of the three brands. A study conducted by the American Petroleum Institute found that premium, mid-grade, and regular grades account for 20, 12 and 68 percent of gasoline sales (API, 1996). An overall composite liquid gasoline profile was constructed based on this relative weighting. The compositions of gasoline headspace vapors were predicted from the measured composition of liquid gasoline using the method described by Kirchstetter et al. (1999). This method is base on the proportionality between the equilibrium headspace partial pressure for each compound identified in gasoline with it's mole fraction in liquid gasoline times the vapor pressure of the pure species. The individual vapor pressures are determined using the Wagner equation.

Gasoline samples (CTGASLnn) were also collected by DRI from the Houston area during summer 1999 (Fujita et. al., 2001). Samples included three grades (regular, mid, and premium) for three brands (Diamond Shamrock, Shell, and Texaco). The compositions of gasoline headspace vapors can be predicted from the measured composition of liquid gasoline using the method described by Kirchstetter et al. (1999).

3.3.4 Commercial Natural Gas and Liquefied Petroleum Gas

The commercial natural gas (CNG) profile is based on samples taken in the summer of 1972 at Los Angeles, CA and in the summer of 1973 at El Monte, CA (Marysohn and Crabtree, 1976; Mayrsohn et al., 1977). The geogenic natural gas (GNG) profile is based upon samples taken in the spring of 1972 in Newhall, CA and at a well head in Redondo Beach, CA in the fall of 1973. The composition of the samples of both types of natural gas did not vary despite the differences in time and location of sample collection (Fujita et al., 1994).

Two liquefied petroleum gas samples were collected from both El Paso (Super Energy Propane and Westex Conversion) and Juarez (Servigas and Commercial de Juarez) during the 1996 Paso del Norte Study, and analyzed by the EPA (Seila et al., 2001). EPA also analyzed one natural gas sample from Juarez.

Two commercial natural gas samples were collected during the 1998 Central Texas On-Road Hydrocarbon Study (Fujita, et al. 1999a) from residential gas lines into 3-liter stainless steel canisters. Sample CTCNG01 is from Lone Star Gas Company and CTCNG02 is from Southern Union Gas Company. A sample of liquefied petroleum gas was transfer to a portable propane tank (CTLPG01) and shipped to DRI for analysis.

3.3.5 Surface Coatings

Although solvents from paints and industrial uses are large components of all ROG inventories, their reported profiles are few (Guo et al., 1998; Kitto et al., 1997). Censullo et al., (1996) reported data for eleven categories of coating. Detailed species profiles were obtained for a total of 106 samples of water-based and solvent-based coating samples. Surface coating profiles for solvent-based industrial maintenance coatings, solvent-based medium gloss/high gloss, solvent-based primers and sealers, quick dry primers and enamels, and thinning solvent were applied in the apportionments. These are largely depleted in the species common to fuel use and production, with larger abundances of styrene, n-decane, and especially "other" compounds. The "other" VOCs are quantified and differ substantially among the different coatings tested. Most of these other compounds are oxygenated compounds that are measured in PAMS. California and other states requires special solvent and coating formulations to comply with air quality emissions requirements. Coating and solvent profiles are likely to be very specific to a particular area.

Printing ink solvents from offset (Wadden et al., 1995a, 1995b) and rotogravure are commonly identified in emissions inventories. Most of these emissions are captured, condensed, and re-used by modern printing facilities, especially the toluene used for thin rotogravure inks. The solvent emission from inks shows enrichments for styrene, n-nonane, and 1,2,4-trimethylbenzene, similar to the other solvents. Again, there is a large “Other” fraction of identified compounds that allow the separation of solvent contributions to ambient VOCs.

A selection of 22 surface coating samples (CTCOATnn) including graphic inks and a variety of architectural and industrial coatings were obtained for analysis by DRI during the 1998 Central Texas On-Road Hydrocarbon Study (Fujita, et al. 1999a). The following table shows the relative abundance of paraffins, olefins, aromatic hydrocarbons, and oxygenated organic compounds for each sample.

The house paint emissions are dominated by oxygenated compounds (between 60 and 80%), while car paint emissions emitted approximately 40% oxygenates, 25% straight chain aliphatics and 25% aromatics. Major oxygenated organic compounds include benzoic acid, 2-(2-butoxyethoxy) ethanol, propylene glycol, butyl acetate, hexyl acetate, hexadecanoic acid, and 2-butoxyethyl acetate.

Mnemonics	ID	Description	paraffin	olefin	aromatic	oxygentate
CTCOAT01	ink01	Toyo Ink Mgf Co Various Ink	21.34%	0.00%	7.00%	71.66%
CTCOAT02	ink02	Prisco A766 Powerklene UK	29.24%	0.00%	19.43%	51.34%
CTCOAT03	ink03	Prisco A216 Superklene 2P	38.62%	0.26%	28.36%	32.77%
CTCOAT04	pnt01	GlasUrit ** 55 Polyester Basecoat	27.83%	0.00%	21.88%	50.28%
CTCOAT06	pnt02	GlasUrit ** 923-94 HS Clear	25.23%	0.14%	34.37%	40.26%
CTCOAT08	pnt03	RM/Limco ** Supreme Enamel Basecoat	23.85%	0.00%	27.52%	48.63%
CTCOAT10	pnt04	RM/Limco ** LC1300 Urethane Clear	30.02%	0.00%	32.31%	37.67%
CTCOAT12	pnt05	RM/Diamont ** M6922 Polyester Basecoat	28.22%	0.00%	31.62%	40.16%
CTCOAT14	pnt06	RM/Diamont ** DC88 Diamond Clear	15.91%	0.00%	35.29%	48.80%
CTCOAT16	pnt07	Sherwin Williams B20 W201 Pro Mar 200 Exterior	6.88%	0.12%	8.20%	84.80%
CTCOAT17	pnt08	Sherwin Williams A82 W596 A-100 Exterior Latex	4.46%	0.00%	8.04%	87.50%
CTCOAT18	pnt09	Sherwin Williams A87 W41 Superpaint Interior Latex	8.17%	0.00%	11.58%	80.24%
CTCOAT19	pnt10	Behr 75 Interior Enamel Undercoat	15.34%	0.00%	10.40%	74.26%
CTCOAT20	pnt11	Behr 436 Exterior Waterbased Primer Sealer	6.39%	0.02%	5.92%	87.67%
CTCOAT21	pnt12	Behr 3050 Interior Semigloss Enamel	4.42%	0.00%	4.41%	91.17%
CTCOAT22	pnt13	Behr 4560 Exterior Flat	18.45%	0.00%	21.42%	60.12%

3.3.6 Organic Decay and Landfills

Landfills are sometimes identified as large TOG emitters owing to their prodigious production of methane (Brosseau and Heitz, 1994). A variety of reactive organic gases may accompany the methane, depending of the nature of the landfill wastes and disposal practices. Brosseau and Heitz (1994) summarize measurements from many landfills, finding acetone, alpha terpinene, benzene, butyl alcohol, dichlorobenzene, dichloromethane, ethylbenzene, ethyl mercaptan, limonene, furans, terpenes, toluene, vinyl acetate, vinyl chloride, and xylene to be among the most abundant components of ROG. Several of these compounds, such as vinyl chloride, are not common to widespread area sources and might be used to determine landfill source contributions by CMB. Kalman (1986) identifies several VOCs outgassed by plastics when they are heated. Acetone was consistently the most abundant ROG found in emissions from the surveyed landfills, probably resulting from the anaerobic decay of discarded organic material. Similar reactions in dumpsters and trash cans, as well as in the natural environment, may account for a portion of the unexplained acetone observed by Fujita et al. (1995b) in Los Angeles and by Singh et al. (1994) at more remote locations. Shonnard and Bell (1993) document substantial quantities of benzene emanating from contaminated soil, a situation that will presumably improve as modern amelioration methods are applied to these dumpsites (Fox, 1996).

The decay samples were collected by DRI from trash bins at Carrow's Restaurant at I35 and Koenig (CTOD01) and from Shoney's Restaurant also off of I35 (CTOD02) during the 1998 Central Texas On-Road Hydrocarbon Study (Fujita, et al. 1999a). These samples contained high amounts of acetaldehyde, MEK, limonene, ethanol, and other oxygenated compound. Two-third of the samples consisted of unidentified compounds.

3.3.7 Meat Cooking and Residential Wood Combustion

Source composition profiles were derived for meat cooking and residential wood combustions using data obtained during the Northern Front Range Air Quality Study (NFRAQS) (Watson et al., 1998b; Fujita et al., 1998c). Although NFRAQS focus on fine particulate, the source sampling for the study included measurements of the associated VOCs. Test for wood combustion included ponderosa pine, pinion pine, Missouri oak, scrub oak, mixed hardwoods (cottonwood, birch, and aspen), and synthetic log burned in a fireplace and in a woodstove (McDonald et al., 2000). Meat cooking tests were conducted for hamburger cooked on both an underfired and automated charbroiler, chicken with skin and steak cooked on an underfired charbroiler, hamburger cooked on a griddle, and chicken without skin cooked on a griddle (McDonald et al., 2003).

3.3.8 Industrial Sources

Petrochemical production, especially the production of gasoline and other fuel oils (Sexton and Westberg, 1979, 1983; Fujita et al., 1995), can be a large contribution in areas such as Houston (Fujita et al., 1995). Ethane, propene, propane, n-pentane, t-2 hexene, benzene, n-heptane, toluene, and n-octane are abundant species. Most of these overlap with liquid and evaporated gasoline vapors. Of particular interest is the large fraction of unidentified NMHC in the canister chromatogram. This fraction includes real, but unreported, chemical compounds that are not in the other profiles. If properly quantified, these could probably assist the CMB resolution of refinery and other petrochemical sources.

A series of net upwind/downwind property-line samples were collected during the COAST Study at ten separate chemical and refining complexes in the Houston area (nine sets from the Exxon Baytown Cluster east of Houston in Baytown; six sets from the Celanese Hoechst Cluster southeast of Houston just south of the Bayport Ship Channel between Shoreacres and Seabrook; four set around the Amoco Industrial Cluster in Texas City; four sets around the Union Carbide facility in Texas City; two sets at the Dow Texas - Plant B facility in Freeport; one set at the Dow Texas - Oyster Creek facility in Freeport; four sets around the Texaco facility at Port Arthur; three sets around the Solvay Polymers Industrial Cluster located east of Houston on the south side of the Houston ship channel; and three sets around the Shell

Industrial Cluster east of Houston between Pasadena and Deer Park on the north side of Highway 225. Additionally, four sets of samples were collected randomly in the Houston Ship Channel along Interstate 10 and Highway 225. Also four sample sets were taken simultaneously at each of two locations to estimate the spatial variability of ambient measurements in the Houston Ship Channel area. The two locations were along Post Oak Road (north/south) and Clinton Drive (east/west).

During the initial source profile development, it was realized that additional point source information was needed to supplement the COAST source measurement (Fujita et al., 1996). Two database files were provided by TNRCC, one file containing source identification information, source location, hourly and/or daily VOC emissions and VOC profile code for each hour (if available, or 24-hour composite profile) and a second file containing the VOC source composition data by profile code. From this information, speciation profiles and composite source profiles were derived by source type and facility-specific source profiles for fifteen facilities located nearest to the Clinton site. Source profiles were also derived for fugitive emissions from petroleum industry facilities, petroleum marketing and storage facilities.

Hydrocarbon samples were collected during the Paso del Norte Study between 8/6/96 and 8/17/96 at several source-specific locations described as Chevron Tank, Chevron Tank South, Chevron Tank FCC, Delmex (ITT), Delmex downwind, Zenco, and Paint Shop. The first three sites are intended to represent fugitive VOC emissions from refinery operations. Delmex and Zenco are located in the industrial area of Juarez, and the paint operation is an auto body shop.

Four ambient samples were collected in industrial areas located along the southeast and eastern edge of the Austin during the 1998 Central Texas On-Road Hydrocarbon Study (Fujita, et al. 1999). These samples primarily reflect a combination of regional background and local vehicular traffic. With the exception of sample CTIND02 which showed higher content of biogenic species from the lumberyard, none of the samples show much evidence of increased halocarbon emissions or and other non-mobile VOC emissions.

Ambient samples were collected within various locations within the industrial areas of the Houston Ship Channel during the 1999 VOC Source Signature Study in Houston, TX (Fujita et al., 2001). Three 50-minute integrated samples were collected in each of the following industrial areas: Deer Park, Pasadena, Galena Park, Baytown, and Bayport. The three samples at each of the five industrial areas were collected during morning, midday and afternoon periods. Two additional sample sets were collected in Texas City area.

3.3.9 Coal-Fired Power Stations

Garcia et al. (1992) found small quantities of VOC emitted by several French coal-fired power stations, with benzene, toluene, ethylbenzene, xylenes, tetrachloroethane, benzaldehyde, and phenol being the most abundant compounds. Abundances of these compounds were substantially enriched over their abundances in the fuel, indicating that these compounds did not combust as well as other fuel components or that they partially formed as part of the combustion process. Some data have also been reported for petroleum fires (Booher and Janke, 1997), food and beverage production (Passant et al., 1993); household products and indoor building materials(Sack et al., 1992), ferry boats (Cooper et al., 1996), the application of hot asphault (Kitto et al., 1997), fish rendering (Ohira et al., 1976), and phytoplankton in the ocean (McKay et al., 1996).

3.3.10 Biogenic Emissions

Biogenic VOC emissions from trees and shrubs (Altshuuller, 1983; Benjamin et al., 1997; Hewitt and Street, 1992; Roberts et al., 1985; Tanner and Zielinska, 1994) are typically reported for isoprene and monoterpenes such as alpha-pinene and beta-pinene. These compounds are very reactive and are usually detected only in forested areas. Isodorov et al. (1985) found a wide variety of heavy hydrocarbons in air dominated by different types of plants and trees that might be more stable indicators of biogenic contributions to ambient VOCs. Because terpenes are not reliably measured in canister samples, isoprene is typically used as a sole marker (i.e., taken to constitute 100 percent of NMHC) in the biogenic emissions profile (BIOGENIC). Biogenic NMHC emissions are highly reactive in the atmosphere, and biogenic source contributions derived from CMB modeling will supply only a lower limit to the actual contributions from biogenic emissions.

3.3.11 Regional Background

Aged emissions can be a significant contributor to VOC composition in urban areas during stagnant period, recirculation (e.g., coastal on-shore and offshore flow), and long-range transport. As emissions undergo photochemical reactions, photochemically stable compounds such as ethane and propane become enriched relative to reactive species. In such cases, the excess ethane and propane are typically assigned to natural gas leaks, petroleum gas leaks or to refinery emissions. Regional background samples may be derived from upwind samples and applied to in CMB to account for these aged emissions.

For example, regional upwind, background VOC compositions were derived from two sets of ambient samples for the 1998 Central Texas On-Road Hydrocarbon Study (Fujita et al., 1999a). Five six-hour samples were collected at the existing Texas Natural Resource Conservation Commission (TNRCC) monitoring stations at San Marcos Airport beginning at midnight. Three ambient samples (CTBIO01, CTBIO02, and CTBIO04) were collected in McKinney Falls State Park at Campsite #48 in order to obtain upwind background samples containing biogenic emissions. A mix of post oak and some live oak surrounds the site. The biogenic species isoprene and α- and β- pinene were removed from the regional profile.

Individual biogenic emissions profiles were included in the CMB analysis for isoprene, α -pinene, and β -pinene. No attempt was made to construct a profile base on the relative emissions of these three species. They were included individually to account for their presence in the ambient samples. Biogenic NMHC emissions are highly reactive in the atmosphere and biogenic source contributions derived from CMB modeling will supply only a lower limit to the actual contributions from biogenic emissions.

3.3.12 Unidentified

Most source profiles used in this study contain a UNID component, which represents the fractional compositions of NMHC that were not assigned to individual, identified species in the gas chromatographic analysis. A single constituent source profile (UNID is taken to constitute 100 percent of NMHC) has been used in the past (Fujita et al., 1994) to account for the contributions from this component. The difference between the measured total NMHC and the sum of the source contributions from fitted sources is named as "unexplained". The "unexplained" source contributions in this report refer to the differences between the measured NMHC and the sum of the predicted contributions from those identified source categories. Nearly all of the unexplained mass is related to UNID that is not assigned to the identified categories. The fraction of UNID is consistently higher in downwind and afternoon samples, which suggests that much of this residual UNID could be secondary organic species produced by photochemical reactions.

4. APPLICATION OF CMB TO PAMS AMBIENT VOC DATA

The user's manual for CMB8 (Watson et. al., 1997) explains the input and output file formats and describes how to operate the software. Each type of input file structure is illustrated with one of the test data sets packaged with CMB8. This section illustrates how to prepare the required input files for the application of CMB8 to VOCs using the macro provided in The Excel file, CMBProfileLibrary.xls.

4.1 Preparing CMB Input Files

Six data files are used for input to CMB8. However, only the ambient and source profile data files are required. Though optional, the remaining four files provide substantial user convenience by establishing commonly used defaults and sample subsets that would otherwise need to be initialized each time CMB8 is run.

CMB input and output files can have any eight-character file name with a three-character extension that indicates the file type. The file naming convention that has been adopted for CMB is **PPXXXXYY.SSS**, where:

- **PP:** Type of file. Common definitions are:
  - **IN**-File identifying other input data file names.
  - **SO**-Source profile selection file, identifying default fitting profiles and source profile descriptions.
  - **PO**-Species selection file, identifying default fitting species.
  - **DS**-Data selection file, identifying samples to be selected from the ambient data file for apportionment during a CMB session.
  - **AD**-Ambient data file, containing the measured ambient concentrations and their precisions.
  - **PR**-Source profile file, containing mass-fraction chemical abundances and their uncertainties.
  - **OU**-Output file, containing report or data base output.
- **XXXX:** Study identifier. This four-letter code allows separate studies to be distinguished from one another.
- **YY:** Session or report identifier. This two-letter code can be assigned to variations on input data files or to distinguish report and data base output files. For example, input data files might be divided up by season or by sampling site to be evaluated in separate CMB modeling sessions. YY might take on the values 'WI' for winter, 'SP' for spring, 'SU' for summer, and 'FA' for fall. Default output filenames can be designated in the options menu with 'RP' identifying the report file and 'DB' representing the data base file. Output files should be written into separate directories, as designated in the Options menu, when different input files are used for the same project.

- **SSS:** File format identifier. The following file extensions are recognized by CMB8:
  - **IN8:** Input filename ASCII text file. CMB8 lists files with this extension when the program is executed and when CMB8 input files are requested using the File menu.
  - **SEL:** Fitting profile, fitting species, and sample selection ASCII text files. CMB8 recognizes files with this extension has containing default selections that can be entered external to the program. This extension applies only to the SO, PO, and DS file types.
  - **CSV:** Ambient data or source profile comma separated value ASCII text file. Each field is separated by a comma. Comma-delimited ASCII data base output files are written with this extension.
  - **DBF:** X-base data base file generated by dBASE or FoxPro compatible data management software. Most commonly used spreadsheets offer this as an output option. DBASE or FoxPro output files are written with this extension.
  - **TXT**: Ambient data or source profile data blank-delimited ASCII text file. Blank-delimited ASCII data base output files are written with this extension.
  - **DAT**: Ambient or source profile data ASCII text file, blank delimited. File structure is identical to TXT extensions.
  - **WKS:** Lotus 1-2-3 version 1 spreadsheet format. Most commonly used spreadsheets offer this as an output option. This is the most useful output format for the data base output file when source contribution estimates will be analyzed using a spreadsheet.

CMB8 converts the CSV, DBF, and WKS input data files to blank-delimited (TXT) files that are actually used by the program. This file carries the TXT suffix and may be used in subsequent modeling sessions to minimize startup time.

4.1.1 Input Filename File

This fixed format file contains a list of the names of other CMB8 input data files. This filename, which is normally entered in response to the first few prompts when CMB8 is started, consists of five lines as shown below. These lines, in succession, contain the names of the files that are described in the following sub-sections. INPAMS.IN8 is an example of this file structure used in CMB8.

```
1         2
01234567890
SOPAMS.SEL
POPAMS.SEL
DSPAMS.SEL
ADPAMS.DBF
PRPAMS.DBF
```

File name entries should be left justified. For the CMB8 32 bit version, the only restriction on file names is that they are acceptable to the operating system. This means that extended file names may be used. For the CMB8 16 bit version, each filename can be up to eight characters in length with up to a three-character suffix, and the fully qualified path plus file name should be less than 256 characters in length. The purpose of this file is to save the effort of keying in the input filename individually. If an INXXXXYY.IN8 filename is not entered at the appropriate prompt, CMB8 will request the names of individual data input filenames.

4.1.2 Source, Species, and Sample Selection Input Files

The source, species and sample selection files provide defaults that do not have to be entered from the program each time a CMB8 session is begun. These files limit the profiles, species, and ambient data records to those listed in the selection files, even though a larger number may be included in the ambient and source profile data files. This means that the data files need not be edited when only subsets of variables are desired for a specific CMB8 modeling session. The source and species selection files also allow default sets of fitting profiles and species to be designated, making it unnecessary to select these at the beginning of each CMB8 session. Variable definitions can also be documented in these files. Sampling site coordinates can be documented in the sample selection file.

Following is an example of the source profile selection file SOPAMS.SEL:

```
0        1         2         3         4
1234567890123456789012345678901234567890
CA1799  CPcomp_1  * * - - - - - - - - Consumer Products
AUST18  CTOD      * - - - - - - - - - Organic Decay
AUST19  CTCNG     - * - - - - - - - - CNG Austin, TX
AUST20  CTLPG01   * * - - - - - - - - LPG Austin, TX
MCH1    COOKING5  * - - - - - - - - - Meat cooking
PAM001  Biogenic  - * - - - - - - - - Biogenic
PAM012  COATcomp  * * - - - - - - - - Composite surface coatings
PAM023  LA_liqGs  * * - - - - - - - - Liquid gasoline
PAM040  LA_HSvap  * * - - - - - - - - Gasoline head space vapor
PAM136  Tu_Sep1   - - - - - - - - - - Sepulveda Tunnel – diesel & min. vapor
PAM137  Tu_Sep2   - - - - - - - - - - Sepulveda Tunnel – diesel & max. vapor
PAM141  Tu_Van0   - - - - - - - - - - Van Nuys Tunnel - diesel
PAM142  Tu_Van1   - - - - - - - - - - Van Nuys Tunnel – diesel & min. vapor
PAM143  Tu_Van2   - - - - - - - - - - Van Nuys Tunnel – diesel & max. vapor
PAM134  Tu_Sep    - - - - - - - - - - Sepulveda Tunnel no correction
PAM138  Tu_TusHD  - - - - - - - - - - Tuscarora Tunnel HD Diesel
PAM140  Tu_Van    - - - - - - - - - - Van Nuys Tunnel no correction
TUN001  TuS95     * * - - - - - - - - Sepulveda Tunnel no corr 1995
TUN002  TuS96     - - - - - - - - - - Sepulveda Tunnel no corr 1996
TUN005  TuMchHDc  * * - - - - - - - - Fort McHenry Tunnel HD Diesel
InkPic  PicoInk1  - - - - - - - - - - Ink from print shop
UNID    UNID      * - - - - - - - - - Unidentified species
BkgAMc  BkgAMc    * - - - - - - - - - AM background in SoCAB
BkgPMc  BkgPMc    - - - - - - - - - - PM background in SoCAB
```

A source code with up to six characters is located in Columns 1 to 6 and an eight-character profile name is located in Columns 9 to 16. Asterisks in Column 19 designates the default fitting profiles when CMB8 is executed, and columns 21,23,25,27, 29, 31,33,35 and 37 can contain nine other default profile combinations that are selectable from the program. The maximum number of species is essentially unlimited. Text comments can be added to this file beginning at the 39th column to document the source profiles.

Following is an example of the species selection file POPAMS.SEL:

```
         1         2         3         4
1234567890123456789012345678901234567890
OTHER   OTHERU    - - - - - -         Other identified species
UNID    UNIDU     * - - - - -         Unidentified species
NMHC    NMHCU     - - - - - -         Total nonmethane hydrocarbons
NMOC    NMOCU     - - - - - -         Total nonmethane organic compounds
ETHENE  ETHENEU   * - - - - -         ethylene
ACETYL  ACETYLU   * - - - - -         acetylene
ETHANE  ETHANEU   * - - - - -         ethane
PROPE   PROPEU    - - - - - -         propene
N_PROP  N_PROPU   * - - - - -         propane
I_BUTA  I_BUTAU   - - - - - -         isobutane
LBUT1E  LBUT1EU   - - - - - -         1-butene
N_BUTA  N_BUTAU   * - - - - -         n-butane
T2BUTE  T2BUTEU   - - - - - -         trans-2-butene
C2BUTE  C2BUTEU   - - - - - -         cis-2-butene
IPENTA  IPENTAU   - - - - - -         n-pentane
PENTE1  PENTE1U   - - - - - -         1-pentene
N_PENT  N_PENTU   - - - - - -         n-pentane
I_PREN  I_PRENU   * - - - - -         isoprene
T2PENE  T2PENEU   - - - - - -         trans-2-pentene
C2PENE  C2PENEU   - - - - - -         cis-2-pentene
BU22DM  BU22DMU   - - - - - -         2,2-dimethylbutane
CPENTA  CPENTAU   - - - - - -         cyclopentane
BU23DM  BU23DMU   - - - - - -         2,3-dimethylbutane
PENA2M  PENA2MU   - - - - - -         2-methylpentane
PENA3M  PENA3MU   - - - - - -         3-methylpentane
P1E2ME  P1E2MEU   - - - - - -         2-methyl 1-pentene
N_HEX   N_HEXU    - - - - - -         n-hexane
MCYPNA  MCYPNAU   - - - - - -         methylcyclopentane
PEN24M  PEN24MU   - - - - - -         2,4 dimethylpentane
BENZE   BENZEU    * - - - - -         benzene
CYHEXA  CYHEXAU   - - - - - -         cyclohexane
HEXA2M  HEXA2MU   - - - - - -         2-methylhexane
PEN23M  PEN23MU   - - - - - -         2,3-dimethylpentane
HEXA3M  HEXA3MU   - - - - - -         3-methylhexane
PA224M  PA224MU   - - - - - -         2,2,4-trimethylpentane
N_HEPT  N_HEPTU   - - - - - -         n-heptane
MECYHX  MECYHXU   - - - - - -         methylcyclohexane
PA234M  PA234MU   - - - - - -         2,3,4-trimethylpentane
TOLUE   TOLUEU    * - - - - -         toluene
HEP2ME  HEP2MEU   - - - - - -         2-methylheptane
HEP3ME  HEP3MEU   - - - - - -         3-methylheptane
N_OCT   N_OCTU    - - - - - -         n-octane
ETBZ    ETBZU     - - - - - -         ethylbenzene
MP_XYL  MP_XYLU   * - - - - -         m&p-xylene
STYR    STYRU     - - - - - -         styrene
O_XYL   O_XYLU    - - - - - -         o-xylene
N_NON   N_NONU    - - - - - -         n-nonane
IPRBZ   IPRBZU    - - - - - -         isopropylbenzene
N_PRBZ  N_PRBZU   - - - - - -         n-propylbenzene
M_ETOL  M_ETOLU   - - - - - -         meta ethyltoluene
P_ETOL  P_ETOLU   - - - - - -         para ethyltoluene
BZ135M  BZ135MU   - - - - - -         1,3,5-trimethylbenzene
O_ETOL  O_ETOLU   - - - - - -         o-ethyltoluene
```

```
BZ124M  BZ124MU   - - - - - -         1,3,4-trimethylbenzene
N_DEC   N_DECU    * - - - - -         n-decane
BZ123M  BZ123MU   - - - - - -         1,2,3-trimethybenzene
DETBZ1  DETBZ1U   - - - - - -         meta-diethylbenzene
DETBZ2  DETBZ2U   - - - - - -         para-diethylbenzene
N_UNDE  N_UNDEU   * - - - - -         n-undecane
```

A species code with up to six characters is located in Columns 1 to 6 and an eight-character species name is located in Columns 9 to 16. Asterisks in Column 19 designates the default fitting species when CMB8 is executed, and columns 21,23,25,27, 29, 31,33,35 and 37 can contain nine other default species combinations that are selectable from the program. The maximum number of species is essentially unlimited. Text comments can be added to this file beginning at the 39th column to document the meaning and units of the chemical components. Nominal afternoon summertime residence times for a reactive environment (e.g., Los Angeles) are estimated in Table 4-1. These are lower limits, but they provide an indication of which components are likely to remain relatively stable between source and receptor, thereby qualifying as fitting species for CMB source apportionment. The table provides a recommended list of fitting species depending on the type of PAMS site and time of day.

For the ambient data records selection file, columns 1 through 12 are for the site ID, columns 14 through 21 are for the date, columns 23 and 24 for the sample duration, columns 26 and 27 for the sample start hour, and columns 29-33 for the particle size fraction, if appropriate. Intermediate columns should be blank. An asterisk in column 35 selects a record. In addition columns 37 through 46 and columns 48 through 57 may contain x and y coordinates, respectively, for use in the Spatial Pie plots (see below). These should be in floating point format, e.g., 123.456, and should increase in value from left to right and from bottom to top. UTM coordinates are suitable as well as fractional longitudes and latitudes, if the longitudes are expressed as negative numbers.

Following is an example of the species selection file DSPAMS.SEL:

```
          1         2         3         4         5         6
1234567898012345678901234567890123456789012345678901234567890
AZUSA         07/27/89 03 06 VOC   * -117.92380 034.13620
PICO          07/27/89 03 06 VOC   * -118.06060 034.14100
BURBANK       07/27/89 03 06 VOC   * -121.93110 037.32300
```

The file structure through the first 5 fields is that of the ambient data input, with columns 1-12 for the site name, columns 13-20 for the sample date, columns 22-23 for the sample duration (in hours), columns 25 and 26 for the sample start time (hour beginning), columns 28-32 for the particle size fraction, column 34 for an asterisk to identify this sample as a section for apportionment, columns 37-45 for the x-coordinate (west-east) of the corresponding sampling sites, and columns 47-55 for the y-coordinate (south-north) of the corresponding site. Site coordinates should be selected so that they are of increasing magnitude from west to east and from south to north. The negative longitude coordinate in columns 37 through 46 above meets that criterion. Coordinates should be in fractional units. UTM coordinates can also be used when they are all from the same zone. These coordinates are used for the spatial plotting display. Site coordinates are optional, and their columns are ignored if they are left blank. Only the first reference to a sampling site code requires coordinates to be supplied. These are assumed to be constant for all subsequent references to this site code.

4.1.3 Generating CMB-Ready Input Files Using Macros in SourceProfileLibrary.xls

The source profile, source selection and species selection files can be automatically generated by running a macro ‘MakeCMBinputFiles’. To create input files for CMB8, go to worksheet 'profiles table' and select all profiles to be included in the source selection file by flagging them with any character in the column labeled Select. Once you have selected all profiles desired switch to worksheet 'defaultSources'. Here you can pre-select up to 10 combinations of source profiles to use in the CMB8 fitting process. A default species selection file can also be generated by editing the green cells in sheet 'defaultSpecies' before creating the species selection file. A set of CMB-ready input files can be generated by running the macro 'MakeCMBinputFiles'. The macro will close this workbook once the files are created, so you may wish to save before running it to preserve your selections. To run the macro press CTRL-m. Individual files can also be created as follows: save the sheet 'spec.sel' or 'source.sel' as a .prn file, then change the extension to .sel . Save the worksheet 'source.dbf' as a dBaseIV file. Click the YES button on the various dialog boxes that appear until the .dbf file is saved.

4.1.4 Ambient Data Input File

CMB8 requires data for source profiles and ambient measurements with one-sigma uncertainty as input data. VOC concentrations are usually reported in ppbC or $\mu g/m^3$ at local temperature and pressure. Either unit is acceptable for CMB analysis, but the source profile ratios must be consistent with the ambient measurements. Fortunately, the fractional abundances of most VOCs relative to NMHC vary by only a few percent when either pppC or $\mu g/m^3$ are used for the numerator and the denominator. Concentrations from all measurement methods must be in the same unit, however.

Ambient data files may be formatted as column-separated values in ASCII text (CSV), xBASE (DBF), blank-delimited ASCII text (TXT), or Lotus Worksheet (WKS). The CSV and DBF formats are preferred, as they are easier to prepare in spreadsheet (e.g. Microsoft Excel, Lotus 123) and data base (e.g. Microsoft Access, dBASE) software than the other formats. The WKS format creates large files and requires substantial translation time for CMB8 input and output, so it is the least desirable of these alternatives. The TXT format is most consistent with CMB7, so older CMB7 data files can be used for CMB8 input without modification. The appropriate file extension must be associated with each format, as CMB8 recognizes the file type by this extension.

The delimited forms of the file do not require fixed format spacing, only that a comma (or a blank character for TXT files) separate each field from prior and subsequent fields. The first line contains the field identifiers, and these must be identical to those named in the selection files. The limitations on each field are:

Field 1:	Site ID (up to 12 characters)
Field 2:	Sampling date (up to 8 characters)

Field 3: Sample duration (up to 2 characters)
Field 4: Sample start hour (up to 2 characters)
Field 5: Particle size fraction (up to 5 characters)
Field 6: Mass concentration (any number of characters in integer, floating point, or exponential format)
Field 7: Precision of mass concentration (same format as Field 6)
Field 8+2n: Concentrations of chemical species (same format as Field 6), where n = 0, 1, 2, ...
Field 9+2n: Precisions of species concentrations (same format as Field 6), where n = 0, 1, 2, ...

CMB8 always assumes that Field 6 is the total mass concentration, and it does not use this as a fitting species. For CMB8 the total number of ambient data records can reach into the thousands, limited only by computer memory. This makes it especially useful for examining multi-species hourly data obtained from automated gas chromatographs. Any other designator can be placed in the size column for non-segregated samples, such as “PM25” or “VOC”.

Missing values for chemical concentrations are designated by placing a -99 in the species concentration and precision fields. A species for which the value is missing cannot be used as a fitting species for that sample. Precisions that exceed zero must be assigned to all chemical concentrations used as fitting species. CMB8 will return an error message when it finds zero or negative precisions.

4.1.5 Source Profile Input File

Source profile data files may be formatted as column-separated values in ASCII text (CSV), xBASE (DBF), blank-delimited ASCII text (TXT), or Lotus Worksheets (WKS). The CSV and DBF formats are the most portable and easily prepared. The appropriate file extension must be associated with each format, as CMB8 recognizes the file type by this extension. The delimited forms of this file do not require fixed format spacing, only that a comma (or a blank character for TXT files) separate each field from prior and subsequent fields. The first line contains the field identifiers, and these must be identical to those named in the selection files. The limitations on each field are:

Field 1: Profile number or source code (up to six characters)
Field 2: Source mnemonic (up to eight characters)
Field 3: Particle size fraction (up to five characters)
Field 4+2n: Fraction of species in primary mass of source emissions (floating point or exponential format), where n = 0, 1, 2, ...
Field 5+2n: Variability of fraction of species in primary mass of source emissions (same format as Field 4), where n = 0, 1, 2, ...

The first record of the profile file contains the species codes for each field. These identifiers can be up to six alphanumeric characters in length, and must correspond to the identifiers used in the ambient data file. Source profile abundances are expressed in fractions of total mass, not in percent. This file does not contain a mass concentration field, as does the ambient data file, because all species abundances have been divided by this mass. The total number of records included depends on the number of species, number of sources, and size of the computer memory.

From one to four different size fraction identifiers may be used, but these must be the same as those used in the ambient data and sample selection files. Missing values for chemical species in source profile files can be replaced by a best estimate with a large uncertainty if they are to be used as fitting species, or with –99 if they will not be used. Default values of 0 for the fraction and 0.0001 to 0.01 for the precision are often chosen for species that are expected to be present in small abundances. This indicates that the species is present in source emissions at a concentration less than .01% to 1%. A smaller value may be appropriate for certain source-types and species. A precision value that exceeds zero must be entered for all fitting species. CMB8 will return an error message when it detects precisions that are less than or equal to zero.

4.2 Output Files

Report and data base output files are produced by CMB8.

4.2.1 Report Output File

The report output file presents the source contribution estimates, standard errors, model performance measures, and measured and calculated chemical concentrations for each sample. The report written to the output file is identical to that which appears in the Output window during an interactive modeling session. It is in ASCII text format and can be imported into word processing programs to document the source contributions calculated for each sample. All information needed to independently repeat the source apportionment is contained in this report. Examples of the report are shown in Section 6.

4.2.2 Data Base Output File

The data base output file records the contribution of each source-type to each chemical species in a single data record. Sample identifiers and model performance measures are also included in each record. This file may be written in blank-delimited (TXT), comma separated values (CSV), xBASE (DBF), or Lotus 123 (WKS) formats (See Sec. 3). The file structure is:

Field 1: Species Code
Field 2: Species Name
Field 3: Fitting flag; a '*' indicates a fitting species, while a '_' indicates a floating species
Field 4: Sampling site identifier
Field 5: Sampling date
Field 6: Sample start hour
Field 7: Sample duration
Field 8: Particle size fraction
Field 9: Measured species concentration
Field 10: Precision of measured species concentration
Field 11: R square value

Field 12: Chi square value
Field 13: Percent of measured mass
Field 14+2n: Source contribution estimate, n = 0, 1, 2, ...
Field 15+2n: Standard error of source contribution estimate, n = 0, 1, 2, ...

Fields 1, 2, and 4 through 10 record the sample information. Fields 3 and 11 through 13 provide information about the CMB calculation. The remaining fields correspond to each source profile in the PRXXXXYY file and contain the source contribution estimates and standard errors for these sources. A value of -99 is recorded when a profile was not used in the calculation.

The first record in this output file contains the field identifiers. All subsequent records contain data. Fields 14+2n and 15+2n are labeled with source codes and source contribution uncertainty columns are labeled with source names.

4.2.3 Reading Output Files

Report text files can be read directly into a word-processing program (e.g. Word or Wordperfect) where the detailed output for each sample can be usually be displayed on a single page with columns aligned using the Courier 8-point to 10-point font. A fixed-with font in which every character occupies the same space is needed for columns to be correctly aligned. Data base output files can be opened directly by database or spreadsheet programs that recognize the CSV, DBF, TXT, and WKS extensions. The contents of the CMB8 output window can also be selected and copied to the clipboard for pasting into other Windows programs. Graphs made with CMB8 can be copied to the Windows clipboard with the Clip button, then pasted into a text box or frame in a word processing program. Pace and Watson (1987) define several performance measures which are examined with each CMB. Each of the CMB results includes values for the performance measures that are used to evaluate the goodness of the solution, following the regulatory guidance of Pace and Watson (1987). The most useful performance measures are source contribution estimate (SCE), standard error (STDERR), t-statistic (TSTAT), R-square (R SQUARE) and chi-square (CHI SQUARE), percent of mass accounted for (PERCENT MASS), max. src. unc. and min. src. Proj, ratio of residual to its standard error (RATIO R/U) and ratio of calculated to measured species (RATIO C/M). These performance measures are explained in the Section 5.3.

Table 4-1

Recommended Fitting Species for PAMS Hydrocarbons

								CMB Fitting Species		
Mnemonics	Names	Formula	AIRS Code	MW	Group	k_{OH} at 298 K	Lifetime hours	Type 2 AM	Type 2 PM	Types 1,3, & 4
ethene	ethene	C_2H_4	43203	28.05	O	8.52	6.52	*		
acetyl	acetylene	C_2H_2	43206	26.04	Y	0.90	61.73	*	*	*
ethane	ethane	C_2H_6	43202	30.07	P	0.27	207.30	*	*	*
prope	Propene	C_3H_6	43205	42.08	O	26.30	2.11			
n_prop	n-propane	C_3H_8	43204	44.10	P	1.15	48.31	*	*	*
i_buta	isobutane	C_4H_{10}	43214	58.12	P	2.34	23.74	*	*	*
lbut1e	1-butene	C_4H_8	43280	56.11	O	31.40	1.77			
n_buta	n-butane	C_4H_{10}	43212	58.12	P	2.54	21.87	*	*	*
t2bute	t-2-Butene	C_4H_8	43216	56.11	O	64.00	0.87			
c2bute	c-2-butene	C_4H_8	43217	56.11	O	56.40	0.99			
ipenta	isopentane	C_5H_{12}	43221	72.15	P	3.90	14.25	*	*	*
pente1	1-pentene	C_5H_{10}	43224	70.13	O	31.40	1.77			
n_pent	n-pentane	C_5H_{12}	43220	72.15	P	3.94	14.10	*	*	*
i_pren	isoprene	C_5H_8	43243	68.11	O	101.00	0.55	+	+	+
t2pene	t-2-Pentene	C_5H_{10}	43226	70.13	O	67.00	0.83			
c2pene	c-2-pentene	C_5H_{10}	43227	70.13	O	65.00	0.85			
bu22dm	2,2-dimethylbutane	C_6H_{14}	43244	86.17	P	2.32	23.95	*	*	*
cpenta	cyclopentane	C_5H_{10}	43242	70.13	P	5.16	10.77	*	*	
bu23dm	2,3-dimethylbutane	C_6H_{14}	43284	86.17	P	6.20	8.96	*		
pena2m	2-methylpentane	C_6H_{14}	43285	86.17	P	5.60	9.92	*	*	
pena3m	3-methylpentane	C_6H_{14}	43230	86.17	P	5.70	9.75	*	*	
p1e2me	2-methyl-1-pentene	C_6H_{12}	43246	84.16	O	31.40	1.77			
n_hex	n-hexane	C_6H_{14}	43231	86.17	P	5.61	9.90	*	*	
mcypna	Methylcyclopentane	C_6H_{12}	43262	84.16	P	8.81	6.31	*		
pen24m	2,4-dimethylpentane	C_7H_{16}	43247	100.20	P	5.10	10.89	*	*	
benze	benzene	C_6H_6	45201	78.11	A	1.23	45.17	*	*	*
cyhexa	cyclohexane	C_6H_{12}	43248	84.16	P	7.49	7.42	*		
hexa2m	2-methylhexane	C_7H_{16}	43263	98.19	P	6.79	8.18	*		
pen23m	2,3-dimethylpentane	C_7H_{16}	43291	100.20	P	4.87	11.41	*	*	
hexa3m	3-methylhexane	C_7H_{16}	43249	100.20	P	7.16	7.80	*	*	
pa224m	2,2,4-trimethylpentane	C_8H_{18}	43250	114.23	P	3.68	15.10	*	*	*
n_hept	n-heptane	C_7H_{16}	43232	100.20	P	7.15	7.77	*		
mecyhx	methylcyclohexane	C_7H_{14}	43261	98.19	P	10.40	5.34	*		
pa234m	2,3,4-trimethylpentane	C_8H_{18}	43252	114.23	P	7.00	7.94	*		
tolue	toluene	C_7H_8	43202	92.14	A	5.96	9.32	*	*	
hep2me	2-methylheptane	C_8H_{18}	43260	114.23	P	8.18	6.80	*	*	
hep3me	3-methylheptane	C_8H_{18}	43253	114.23	P	8.56	6.49	*		
n_oct	n-octane	C_8H_{18}	43233	114.22	P	8.68	6.40	*		
etbz	ethylbenzene	C_8H_{10}	45203	106.16	A	7.10	7.82	*		
mp_xyl	mp-xylene	C_8H_{10}	45109	106.16	A	18.95	4.71			
styr	styrene	C_8H_8	45220	104.14	A	58.00	0.96			
o_xyl	o-xylene	C_8H_{10}	45204	106.17	A	13.70	4.06			
n_non	n-nonane	C_9H_{20}	43235	128.26	P	10.20	5.45	*		
iprbz	isopropylbenzene	C_9H_{12}	45210	120.20	A	6.50	8.55	*		
n_prbz	n-propylbenzene	C_9H_{12}	45209	120.20	A	6.00	9.26	*		
m_etol	m-ethyltoluene	C_9H_{12}	45212	120.20	A	19.20	2.89			
p_etol	p-ethyltoluene	C_9H_{12}	45213	120.20	A	12.10	4.59			
bz135m	1,3,5-trimethylbenzene	C_9H_{12}	45207	120.20	A	57.50	0.97			
o_etol	o-ethyltoluene	C_9H_{12}	45211	120.20	A	12.30	4.52			
bz124m	1,2,4-trimethylbenzene	C_9H_{12}	45208	120.20	A	32.50	1.71			
n_dec	n-decane	$C_{10}H_{22}$	43238	142.29	P	11.60	4.79	*		
bz123m	1,2,3-trimethylbenzene	C_9H_{12}	45225	120.20	A	32.70	1.70			
detbz1	m-diethylbenzene	$C_{10}H_{14}$	45218	134.22	A	14.20	3.90			
detbz2	p-diethylbenzene	$C_{10}H_{14}$	45219	134.22	A	14.20	3.90			
n_unde	n-undecane	$C_{11}H_{24}$	43954	156.30	P	13.20	4.20	*		

A = aromatic, AL = Aldehyde, O = alkene (olefin), P = parafin, Y = alkyne, K = ketone, E = ether, X = haogenated, OH = alcohol

Note: Rate constants k at 298 K for the reaction of OH radicals with VOCs. Unit: 10^{12} x k cm^3 $molecule^{-1}$ s^{-1}

+ Included because single species source. Will underestimate true contribution due to reactivity.

5. CMB APPLICATION AND VALIDATION

This section examines the procedures for evaluating the validity of the application of CMB to PAMS VOC data. These procedures are described in the applications and validation protocol for CMB8 (Watson et al., 1998). Although the protocol was originally developed for PM_{10} source assessment, it contains many general features that are applicable to the source apportionment of VOCs. The protocol consists of seven steps: 1) determination of model applicability; 2) initial source contribution estimates; 3) examination of model outputs and performance measures; 4) identification of deviations from model assumptions; 5) identification and correction of model input errors; 6) verification of the consistency and stability of source contribution estimates; and 7) evaluation of the results of the CMB analysis with respect to other source assessment methods.

5.1 CMB Model Applicability

The requirements for CMB model applicability are as follows: 1) a sufficient number of receptor samples is taken with an accepted method to evaluate temporal and spatial variations in hydrocarbon mixing ratios; 2) samples are analyzed for chemical species which are also present in source emissions; 3) potential source contributors have been identified and chemically characterized; and 4) the number of non-collinear source types is less than the number of measured species.

The sampling and analytical methods that are employed in the PAMS program for determining ambient levels of speciated hydrocarbons and carbonyl compounds are well established (see Section 2). Several laboratory comparisons have shown that the identification and quantification of the 55 target PAMS species are reasonably consistent among the PAMS analytical laboratories. These compounds typically comprise 70 to 80 percent of the total NMOC in urban areas. Eight 3-hour samples per day are collected daily at Type 2 sites and every third day at all other PAMS sites. Automated gas chromatographs are used in some PAMS programs, which provide hourly monitoring. The source types that potentially contribute to ambient VOC in urban areas are: 1) motor vehicle exhaust; 2) gasoline vapors; 3) diesel exhaust; 4) architectural and industrial coatings; 5) gas leaks (natural, geogenic and liquefied petroleum gas); and 6) biogenic emissions. Regionally specific profiles have been compiled in recent years for most of these sources. The number of suitable fitting species that can be used in the CMB analysis of PAMS VOC data exceeds the number of potential source types (up to 12 source types). Given these facts, the CMB receptor model is applicable to source apportionment of the assembled hydrocarbon data base.

Although the PAMS enhanced monitoring program has significantly expanded the database available for VOC receptor modeling, we note the following possible limitation in their applications to CMB.

- With the exception of some carbonyl compounds, the PAMS speciation is currently limited to hydrocarbons. Most of these hydrocarbons are associated with emission from mobile sources. Surface coatings may be apportioned based on the relative abundance of toluene, cycloalkanes, and higher molecular weight n-alkanes. Surface coatings also contain oxygenated organic compounds such as ethers and acetates that are not measured by PAMS sampling and analytical methods. Other source that emits oxygenated organic compounds, such as biogenic emissions, meat cooking, wood combustion, may also be underrepresented in the apportionment.

- As with any directly emitted pollutant, the spatial representativeness of the ambient sample should be carefully examine. Mobile sources are ubiquitous in urban areas and will be detected in all urban ambient samples. Stationary and other area sources are spatially more dispersed than mobile sources and their source contributions would depend upon their proximity to the PAMS monitoring location. It is advisable in the design of ambient source apportionment studies to include short-term saturation monitoring near the PAMS site to characterize the spatial variations in the apportionments.

- Total NMOC is operational defined based on the selectivity and specificity of the analytical methods. These totals should be reconciled with a more comprehensive measurement of ambient VOCs.

- For PAMS VOC, the apportionment of diesel exhaust is based primarily on n-decane and n-undecane. However, these compounds are also emitted by gasoline vehicles and other sources such as surface coating. Inclusion of semi-volatile (C_{11}-C_{18}) hydrocarbons provides greater discrimination among these sources. These compounds require sampling on solid adsorbents, a methods that is not part of the current PAMS program.

5.2 Initial Source Contribution Estimates

Initial source contribution estimates should be derived from a subset of samples in order to select a default combination of source profiles and fitting species for the ambient data. These initial evaluations should include the following source types in different combinations: 1) motor vehicle exhaust; 2) liquid gasoline, 3) gasoline vapor; 4) surface coatings; 5) industrial sources, and 5) miscellaneous. Alternative source profiles should be used in the CMB analysis for each of the major source categories to determine the variations in the source contributions and model performance (see next section). The MPIN matrix identifies the fitting species that have the most influence on the source attribution. These model performance parameters provide a basis for selecting the mose appropriate profile among the alternatives.

Because the apportionment between vehicle exhaust, whole gasoline and gasoline vapor can vary substantially depending on the selection of profiles, it is important to consider what these profiles actually represent. Tailpipe emissions are a mixture of hydrocarbons produced during combustion along with unburned gasoline resulting from incomplete combustion. Siegl et al. (1992) showed that unburned fuel represents most (>50 percent) of the hydrocarbon emissions from a spark-ignited single-cylinder engine. In the CMB calculations, liquid gasoline represents the additional unburned gasoline (due to misfiring and other engine malfunctions) that is not included in the exhaust profile, plus evaporative emissions from gasoline spillage and hot soaks. The profile for gasoline headspace vapors reflects evaporative emissions due to refueling, diurnal emissions and running losses. Isopentane, n-butane, n-pentane, 2-methylpentane, 3-methylpentane, toluene and m,p-xylene are typically the most abundant species in liquid gasoline. Because exhaust emissions and liquid gasoline contain many species in common, the attribution of source contributions among these two categories depends largely on the ratio of acetylene and light olefins to NMHC in the exhaust composition profile. Some of the "real-world" factors that affect this ratio include: 1) emissions due to non- catalyst vehicles versus catalyst-equipped vehicles; 2) contributions from high emitters; 3) different driving modes; and 4) vehicle speed and load. The profile for gasoline headspace vapors reflects evaporative emissions due to refueling, diurnal evaporation, and running losses. The major components for this source include isopentane, n-butane and n-pentane. Because running losses are already included in the on-road profile, the balance would be due to refueling and diurnal evaporative emissions.

The relative attribution between on-road gasoline emissions and liquid gasoline and gasoline vapor depends upon the nature of the vehicle fleet near the sampling site. A few high-emitters near the site can result in greater attribution to gasoline, while the absence of high-emitters can result in lower attribution to on-road gasoline tailpipe emissions. With respect to the relative importance of vehicle exhaust versus liquid gasoline, we have shown that the attribution of source contributions among the motor vehicle source categories is highly sensitive to the relative abundance of combustion by-products in the exhaust profile (Fujita et al., 1994). Exhaust profiles with higher acetylene and ethene (if used as fitting species) abundances yield lower source contributions for exhaust and higher source contributions for liquid gasoline. While the source attributions between exhaust and liquid gasoline may vary with different exhaust profiles, sensitivity runs showed that the sum of the two source contributions are less variable (Fujita et al., 1994).

In recent CMB studies (Fujita et al., 2003a) we have seen a decline in the contribution of whole gasoline. This may be due replacement of carburetors with fuel-injection engines, which produce substantially lower amounts of hotsoak emissions. In addition, evaporative emissions resembling headspace can be greater for fuel-injection engine when there is a malfunction of the canister/purge system because gasoline temperatures are higher in fuel injection engine due to recirculation of the fuel from the engine back to the tank. With the introduction of the catalytic converter, ethene and acetylene have both decreased as a fraction of total NMHC. However, the decrease for acetylene has been greater because the catalyst removes it more efficiently. Well-maintained catalyst-equipped vehicles have ethene/acetylene ratios of three or greater based upon FTP emission tests (Hoekman, 1992; Sigsby et al., 1987), while non-catalyst vehicles have ethene/acetylene ratios near one (Hoekman, 1992; Black, et al., 1980). Fuel-rich conditions (Siegl et al., 1992; McCabe et al., 1992) due to engine malfunction or "open-loop" operation during high acceleration and load can also produce lower ethene/acetylene ratios relative to normal emitters under closed-loop operation. With the turnover of the vehicle fleet to newer emission control technologies, the fraction of total vehicle exhaust emissions that are contributed by vehicles with malfunctioning emission controls and fuel-rich driving conditions has likely increased. This is a possible explanation for the shift in average ambient ethene/acetylene ratios in the South Coast Air Basin from 1.5 in 1987 during the Southern California Air Quality Study (Fujita, et al., 1994) to1.8 in 1990 (Zielinska et al., 1992) and 0.9 in 1995 (Fujita et al., 1997a).

5.3 Model Outputs and Performance Measures

Pace and Watson (1987) define several performance measures which are examined with each CMB. Table 5-1 shows examples of a typical CMB run and the performance measures associated with it. The output contains every specification for the configuration under which the model was applied. The upper part of the display shows the source profiles included in each model application. The lower part of the display shows the species that were measured at the receptor and the species which were included in the CMB calculation (indicated by a ‘*’ under the column labeled 'I').

Each of the CMB results includes values for the performance measures that are used to evaluate the goodness of the solution, following the regulatory guidance of Pace and Watson (1987). The most useful performance measures are:

- Source Contribution Estimate (SCE). This is the contribution of each source type to the pollutant being apportioned, which is usually the mass concentration. Each of the SCE should be greater than zero and none should exceed the total mass concentration.
- Standard Error (STDERR). This is an indicator of the precision or certainty of each SCE. The STDERR is estimated by propagating the precisions of the receptor data and source profiles through the effective variance least-squares calculations. Its magnitude is a function of the uncertainties in the input data and the amount of collinearity (i.e., degree of similarity) among source profiles. It is desirable to have this value be much less than the source contribution estimate. When the SCE is less than the STDERR, the STDERR is interpreted as an upper limit of the source contribution.
- t-Statistic (TSTAT). This is the ratio of the source contribution estimate to the standard error. A high value for TSTAT (>2.0), shows that the relative precision of the source contribution estimate is high and that the contribution is significant. A low TSTAT value (<2.0) means that a source contribution is not present at a level which exceeds two times the STDERR. Twice the STDERR is a reasonable estimate of the upper limit for a source contribution when TSTAT <2.0.
- R-Square (R SQUARE) and Chi-Square (CHI SQUARE). The R SQUARE measures the variance in the receptor concentrations which is explained by the calculated species concentrations. The CHI SQUARE statistic is the weighted sum of the squares of differences between calculated and measured species concentrations divided by the effective variance and the degrees of freedom (DF). A low R SQUARE (<0.8) indicates that the selected source profiles have not accounted for the variance in the selected receptor concentrations. A large CHI SQUARE (>4.0) means that one or more of the calculated species concentrations differs from the measured concentrations by several uncertainty intervals. The values for these statistics exceed their targets when: 1) contributing sources have been omitted from the CMB calculation; 2) one or more source profiles have been selected which do not represent the contributing source types; 3) precisions of receptor or source profile data are underestimated; and/or 4) source or receptor data are inaccurate.

- Percent of Mass Accounted For (PERCENT MASS). This is the ratio of the sum of the source contributions to the measured mass for particulate samples. The target value is 100%, with a reasonable range of 80% to 120%. Percent mass values which are outside of this range result when: 1) source profiles have been incorrectly specified; 2) contributing source types have been omitted from the calculation; 3) mass or chemical species measurements are inaccurate; and/or 4) mass measurements are less than 10 $\mu g/m^3$ and within a few precision intervals of the measurements.

- Max. Src. Unc. and Min. Src. Proj. These are used in Ron Henry's eligible space treatment of collinearity (Henry, 1992). This treatment uses two parameters, maximum source uncertainty and minimum source projection on the eligible space. These are set to default values of 1.0 and 0.95, respectively, in CMB8. Briefly, the maximum source uncertainty determines the eligible space to be that spanned by the eigenvectors whose inverse singular values are less than or equal to the maximum source uncertainty. Estimable sources are defined to be those projections on the eligible space that is at least the minimum source projection. Inestimable sources are sources that are not estimable. To modify these values click in the edit boxes and edit with keyboard entry. With a maximum source uncertainty of 1.05, the sample input file testport.inp reproduces the example in the paper by Henry.

- Ratio of Residual to Its Standard Error (RATIO R/U). This column contains the ratio of the signed difference between the calculated and measured concentration (the residual) divided by the uncertainty of that residual (square root of the sum of the squares of the uncertainty in the calculated and measured concentrations). The RATIO R/U specifies the number of uncertainty intervals by which the calculated and measured concentrations differ. When the absolute value of the RATIO R/U exceeds 2, the residual is significant. If it is positive, then one or more of the profiles is contributing too much to that species. If it is negative, then there is an insufficient contribution to that species and a source may be missing. The sum of the squared RATIO R/U for fitting species divided by the degrees of freedom yields the CHI-SQUARE. The highest RATIO R/U values for fitting species are the cause of high CHI SQUARE values.

- Ratio of Calculated to Measured Species (RATIO C/M). The column entitled RATIO C/M shows the ratio of calculated to measured concentration and the standard error of that ratio for every chemical species with measured data. The ratios should be near 1.00 if the model has accurately explained the measured concentrations. Ratios which deviate from unity by more than two uncertainty intervals indicate that an incorrect set of profiles is being used to explain the measured concentrations. The RATIO C/M for most species is within the target range for each example.

The application of continuous speciated VOC data in source apportionment offers additional insights regarding the temporal variations in source contributions that are difficult to discern from a limited number of canister samples that are integrated over a period of 3 hours or more. The following graphical display show examples of CMB results obtained from hourly speciated hydrocarbon data.

- Average source contribution estimates of ambient hydrocarbons by hour of day (e.g., Figure 5-1)

- Diurnal plots of the average CMB source contribution estimates by site for each day of the week (e.g., Figure 5-2).

- CMB source contributions and residual hydrocarbon concentrations and graphical displays of residuals by wind direction and time of day (e.g., Figure 5-3).

Another useful graphical display that can also be applied to time-integrated canister samples show relationships between source contribution estimates (in particular the residual unexplained mass) and extent of reaction of the ambient air sample (estimated by a ratio of reactive to unreactive hydrocarbon species. Scatterplots of CMB-predicted versus measured concentrations for reactive species by site and time of day are also useful in examining the photochemical age of the ambient hydrocarbons.

5.4 Deviations from Model Assumptions

The basic assumptions of the CMB model (Watson, 1979) are: 1) compositions of source emissions are constant over the period of ambient and source sampling; 2) chemical species do not react with one another (i.e., they add linearly); 3) all sources which may significantly contribute to the receptor have been identified and their emissions characterized; 4) the number of source categories is less than or equal to the number of chemical species; 5) the source profiles are linearly independent (i.e., they are statistically different); and 6) measurement uncertainties are random, uncorrelated, and normally distributed. The degree to which these assumptions are met in practice depends to a large extent on the types and quality of chemical measurements made at the sources and receptor.

A prerequisite for using receptor models is that the relative proportions of chemical species change little between source and receptor. Most ambient VOCs are oxidized in the lowest 2 km of the troposphere with tropospheric lifetimes ranging from hours to several months. For the majority of organic compounds emitted into the troposphere from either biogenic or anthropogenic sources, reaction with the OH radical is the major chemical loss process (Atkinson, 1989). Some volatile organic compounds react significantly with O_3 and/or degrade by thermal decomposition or photolysis. However, removal by reaction with O_3, or due to photolysis, can be estimated to be much less than 1% of the OH removal rate for most VOCs. Kinetics and mechanisms of the gas-phase reactions of the hydroxyl radical with organic compounds have been reviewed and evaluated by Atkinson (1989, 1990). Rate constants are also recommended for organic compounds for which experimental data do not exist. Table 2-1 lists the rate constants and lifetimes of some hydrocarbons due to reaction with OH radical. The reactions are assumed to be of second order with reactant half life and lifetime of $t_{1/2} = 0.693/k[\mathrm{OH}]$ and $\tau = 1/k[\mathrm{OH}]$, respectively. Actual overall lifetimes may be shorter owing to competing loss processes such as photolysis. Since OH concentrations vary with the intensity of solar radiation, lifetimes will vary by location, season and time of day (Finlayson-Pitts, 1986).

For the CMB calculations performed for PAMS hydrocarbon data, only species with sufficiently long lifetimes should be used as fitting species. The summer lifetime of toluene (~9 hours) serve as a general guideline for most samples. Exceptions would apply to morning samples in the source areas when most emissions are expected to be "fresh" and to upwind background and downwind afternoon "aged" samples. Table 4-1 provides suggestions for subsets of fitting species that may be considered for each type of sample.

Figures 5-4 and 5-5 present scatterplots of calculated (sum of CMB-derived contributions) and measured concentrations of benzene, isopentane, toluene, ethylene, m&p-xylene, and propene for samples from Azusa (downwind high ozone site) and Los Angeles – North Main (source site), respectively. The figures contain separate plots for the 0700-1000 and 1400-1700 PDT sampling periods. The scatterplots are arranged by species according to increasing reactivity from left to right and top to bottom. Benzene, isopentane and toluene are among the 27 hydrocarbons that were used as fitting species in the CMB modeling. Ethylene, m&p-xylene, propene, and other reactive hydrocarbons were not used in the fit and have no effect on the apportionment. Because the contributions for the reactive species are calculated based on apportionments of NMHC using non-reactive species, the predicted concentrations for reactive species exceed the measured values by margins that increase with increasing reactivity of the species. This effect is clearly evident in the figures. Azusa, which is the downwind site, shows larger differences between predicted and measured concentrations for reactive species in afternoon samples. The divergence in slopes for morning versus afternoon samples increases from ethylene to m&p-xylene to propene. Regardless of the species, the predicted and measured concentrations are generally in good agreement for the morning samples, indicating that ambient hydrocarbons are dominated by fresh emissions during this period at all three sites. Los Angeles – North Main appears to be dominated by fresh emission in the afternoon as well. This is not surprising since the site is located in the western portion of the air basin and traffic near the site is heavy throughout the day. These analyses show that by limiting the CMB fit to species with atmospheric lifetimes that exceed their residence times in the Basin, we have effectively minimized the effects of reactivity on the CMB results. These observations also indicate that additional reactive species can be used in the CMB fit for morning samples in the SoCAB and at locations near the coast where prevailing winds transport aged emissions from the area.

Isoprene is an exception to the general rule. It is included as a fitting species despite its high reactivity because it serves as a marker for biogenic emissions. The source contribution estimates underestimated the actual source contributions of biogenic emissions, i.e., they provide a lower limit to biogenic contributions. Reactive species are retained in the CMB modeling as "floating species", and provide useful diagnostic information. Because the concentrations for these species are calculated by the CMB model based on apportionments of NMHC using non-reactive species, the predicted concentrations for reactive species exceed the measured values by margins that increase with increasing reactivity of the species. Regardless of the species, the predicted and measured concentrations are generally in good agreement for morning samples indicating that ambient hydrocarbons are dominated by fresh emissions during this period.

We examined changes between morning and afternoon samples in the ratios of reactive hydrocarbons (isomers of xylene) to a relatively unreactive hydrocarbon (benzene) from a common source (i.e., vehicle exhaust) as an indicator of the net fractional loss of reactive hydrocarbon, such as isoprene, between the two sampling periods. These ratios are invariant to atmospheric dispersion and include continuous injections of fresh emissions into the air parcel during its transport to the sampling site. The average ratio of the afternoon to morning xylenes/benzene ratios reflect the net fractional loss of xylenes due to atmospheric reactions. This fractional loss can be adjusted to isoprene by applying the ratio of the OH radical reaction rate constants for xylenes (18.8 assuming ratios of meta, para, and ortho isomers concentrations of 2:1:1) and isoprene (101). However, isoprene is emitted during daylight hours only with maximum emission rates during mid-day. Estimates of daily biogenic emissions based upon daytime ambient measurements would overestimate their contribution relative to anthropogenic sources. The exclusion of other biogenic species and use of daytime ambient isoprene measurements tend to offset one another in estimating total biogenic emissions. Therefore, the ratio of the afternoon to morning xylenes/benzene ratios, adjusted for relative reactivity of isoprene provides an estimate of the reactivity adjusted source contributions of all biogenic emissions.

With respect to Assumption 3 involving the inclusion of all source types, it appears from the PERCENT MASS performance measures that all of the significant contributors have been included in most of the CMBs. For certain samples that have a large portion of “unidentified” species, the ambient NMHC were not fully accounted for by the sources included in the model. It is impossible for the CMB model to extract interpretation from this "unidentified" fraction until it is further resolved into specific compounds or compound groups by chemical analysis.

With respect to Assumption 4 concerning number of species and number of sources, 27 VOCs and up to 12 source profiles were used in each calculation. The number of chemical species always exceeded the number of source types.

With respect to Assumption 5 concerning collinearity, the initial source contribution estimates show the potential for collinearity among exhaust, liquid gasoline and gasoline vapor profiles. Uncertainty/Similarity Clusters (U/S CLUSTERS) defined by Watson et al. (1991) and based on the methods of Henry (1982; 1992) often appeared during the analyses which grouped together two or more of the profiles. The U/S CLUSTERS do not necessarily mean that profiles are collinear -- they really mean that the standard error assigned to a category representing the profiles in the clusters might be lower than the standard errors assigned to the individual source contribution estimates associated with each profile. Though the standard errors for these source types often approach 30% of the source contribution estimate, indicating collinearity uncertainty in addition to propagated analytical uncertainty, all three vehicle profiles were usually retained so that temporal and spatial variations in their contributions could be examined.

The effects of deviations from Assumption 6 on the randomness and normality of measurement errors remain to be studied. For this study, all of the CMB assumptions are met to the extent that the source contribution estimates can be considered valid.

5.5 Identification and Correction of Model Input Errors

Physically unreasonable concentrations for certain chemical species are usually evident from by large CHI-SQUARE values with a large R/U value for the related species. In these cases the suspect species should be removed from the fit. An example is the coelution of 2,3-dimethylbutane with MTBE. In general, the CMB modeling was robust enough that, when performance measures were within acceptable ranges around target values, there was little effect of suspect concentrations on the source contribution estimates.

5.6 Consistency and Stability of Source Contributions

The source contribution estimates and the statistics and diagnostic information are reviewed to determine the validity of the initial model results. The analysis is repeated by eliminating source profiles that gave negative source contribution estimates or standard errors that exceed the source contribution estimates. A new feature of CMB8 is that the software can remove these insignificant sources automatically. The measured ambient NMHCs indicate that all major source types were included in the calculations, that ambient and source profile measurements are reasonably accurate, and that the source profiles are reasonably representative of actual emissions.

Table 5-1
Example CMB8 Output

```
SOURCE CONTRIBUTION ESTIMATES -  SITE: NM           DATE: 09/13/95     CMB 8.0
SAMPLE DURATION        1       START HOUR        06        SIZE:    G
       R SQUARE      0.97    PERCENT MASS     105.7
     CHI SQUARE      1.68              DF        24



  SOURCE
      * TYPE     SCE(UG/M3)    STD ERR      TSTAT
-------------------------------------------------
 c02    MchHD        103.24      15.11       6.83
 c08    Ex_V1        321.78      28.71      11.21
 c72    LA_Hs        128.38      26.30       4.88
 c91    CNG           14.21       4.59       3.10
 c92    GNG           41.02      11.95       3.43
 c93    LPG           13.95       4.77       2.92
 c95    AC_196         2.07       1.44       1.44
 c96    IC_783        26.43       8.32       3.18
 c99    Unid          64.69      18.06       3.58
-------------------------------------------------

MEASURED CONCENTRATION FOR SIZE: G
     677.3+-    44.7

ELIGIBLE SPACE DIM. =   0 FOR MAX. UNC. =     1.00

1 / SINGULAR VALUE
--------------------------------------------------------------------------------
.1382E+01 .3050E+01 .4340E+01 .6912E+01 .9504E+01 .1403E+02 .1806E+02 .2038E+02
.3496E+02
--------------------------------------------------------------------------------

NUMBER ESTIMABLE SOURCES =   0 FOR MIN. PROJ. =  0.95
 PROJ. SOURCE   PROJ. SOURCE   PROJ. SOURCE   PROJ. SOURCE   PROJ. SOURCE
--------------------------------------------------------------------------------
0.0000 c02     0.0000 c08     0.0000 c72     0.0000 c91     0.0000 c92
0.0000 c93     0.0000 c95     0.0000 c96     0.0000 c99
--------------------------------------------------------------------------------

ESTIMABLE LINEAR COMBINATIONS OF INESTIMABLE SOURCES
COEFF. SOURCE  COEFF. SOURCE  COEFF. SOURCE  COEFF. SOURCE   SCE         STD ERR
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------

SPECIES CONCENTRATIONS -  SITE: NM           DATE: 09/13/95       CMB 8.0
SAMPLE DURATION        1       START HOUR        06        SIZE:    G
       R SQUARE      0.97    PERCENT MASS     105.7
     CHI SQUARE      1.68              DF        24

SPECIES-------I---MEAS------------------CALC-------------RATIO C/M----RATIO R/U
NMHC   NMHCU  T    677.30+-    44.70    715.78+-    26.86   1.06+- 0.08     0.7
ETHANE ETHANE *     22.04+-     0.62     22.18+-     2.40   1.01+- 0.11     0.1
ETHENE ETHENE       22.49+-     0.56     26.40+-     3.15   1.17+- 0.14     1.2
ACETYL ACETYL *     24.97+-     1.21     21.76+-     2.29   0.87+- 0.10    -1.2
LBUT1E LBUT1E        1.85+-     0.14      4.17+-     0.76   2.25+- 0.45     3.0
LIBUTE LIBUTE        6.47+-     0.26      7.92+-     0.67   1.22+- 0.11     2.0
PROPE  PROPEU        9.38+-     0.36      8.57+-     1.41   0.91+- 0.15    -0.6
N_PROP N_PROP *     31.23+-     1.03     31.25+-     3.33   1.00+- 0.11     0.0
I_BUTA I_BUTA *      9.22+-     0.37      6.76+-     1.30   0.73+- 0.14    -1.8
N_BUTA N_BUTA *     15.95+-     0.65     18.73+-     3.10   1.17+- 0.20     0.9
T2BUTE T2BUTE        1.57+-     0.13      2.08+-     0.47   1.32+- 0.32     1.0
C2BUTE C2BUTE        1.07+-     0.33      1.54+-     0.24   1.44+- 0.50     1.1
```

```
IPENTA IPENTA *     40.44+-     1.32     47.36+-     7.49   1.17+- 0.19     0.9
PENTE1 PENTE1        1.65+-     0.29      2.07+-     0.27   1.25+- 0.27     1.1
N_PENT N_PENT *     20.53+-     1.43     18.23+-     1.78   0.89+- 0.11    -1.0
I_PREN I_PREN *      1.02+-     0.31      1.01+-     0.30   0.99+- 0.42     0.0
T2PENE T2PENE        2.00+-     0.34      2.69+-     0.48   1.35+- 0.33     1.2
C2PENE C2PENE        1.10+-     0.17      1.66+-     0.24   1.51+- 0.32     1.9
B2E2M  B2E2MU        2.44+-     0.32      4.01+-     0.55   1.64+- 0.31     2.5
BU22DM BU22DM *      1.48+-     0.18      2.92+-     0.93   1.97+- 0.68     1.5
CPENTE CPENTE        0.60+-     0.10      0.96+-     0.22   1.60+- 0.45     1.5
P1E4ME P1E4ME        0.53+-     0.17      0.53+-     0.26   1.01+- 0.58     0.0
CPENTA CPENTA *      2.54+-     0.21      1.91+-     0.25   0.75+- 0.12    -1.9
BU23DM BU23DM        4.67+-     0.21      3.42+-     0.68   0.73+- 0.15    -1.8
PENA2M PENA2M *     17.98+-     0.95     17.46+-     1.22   0.97+- 0.09    -0.3
PENA3M PENA3M *     10.43+-     1.37      9.28+-     0.76   0.89+- 0.14    -0.7
P1E2ME P1E2ME        0.48+-     0.14      0.40+-     0.38   0.83+- 0.82    -0.2
N_HEX  N_HEXU *     10.45+-     0.63     13.40+-     3.32   1.28+- 0.33     0.9
T2HEXE T2HEXE        0.80+-     0.21      1.22+-     0.43   1.52+- 0.67     0.9
C2HEXE C2HEXE        0.36+-     0.06      0.42+-     0.13   1.18+- 0.41     0.5
MCYPNA MCYPNA *     12.84+-     0.52      8.64+-     3.48   0.67+- 0.27    -1.2
PEN24M PEN24M *      4.05+-     0.22      6.55+-     2.12   1.62+- 0.53     1.2
BENZE  BENZEU *     14.49+-     2.05     15.66+-     1.53   1.08+- 0.19     0.5
CYHEXA CYHEXA *      4.08+-     0.37      4.00+-     0.40   0.98+- 0.13    -0.2
HEXA2M HEXA2M *      7.22+-     0.33      9.23+-     3.18   1.28+- 0.44     0.6
PEN23M PEN23M *      6.95+-     0.53      8.99+-     1.50   1.29+- 0.24     1.3
HEXA3M HEXA3M *      8.48+-     0.63      9.75+-     1.37   1.15+- 0.18     0.8
PA224M PA224M *     11.30+-     0.39     12.78+-     2.39   1.13+- 0.22     0.6
N_HEPT N_HEPT *      6.12+-     0.29      5.41+-     0.49   0.88+- 0.09    -1.2
MECYHX MECYHX *      6.83+-     0.37      7.08+-     0.72   1.04+- 0.12     0.3
PA234M PA234M *      3.05+-     0.16      4.16+-     1.22   1.36+- 0.41     0.9
TOLUE  TOLUEU *     44.31+-     1.52     47.82+-     5.42   1.08+- 0.13     0.6
HEP2ME HEP2ME *      3.23+-     0.32      3.87+-     0.37   1.20+- 0.16     1.3
HEP3ME HEP3ME *      2.96+-     0.15      3.50+-     0.55   1.18+- 0.20     0.9
N_OCT  N_OCTU *      2.77+-     0.25      2.36+-     0.31   0.85+- 0.14    -1.0
ETBZ   ETBZU         7.63+-     0.34      7.70+-     1.94   1.01+- 0.26     0.0
MP_XYL MP_XYL       30.04+-     1.17     31.75+-     6.62   1.06+- 0.22     0.3
STYR   STYRU         3.18+-     0.17      2.41+-     0.71   0.76+- 0.23    -1.1
O_XYL  O_XYLU       10.58+-     0.37     12.81+-     2.25   1.21+- 0.22     1.0
N_NON  N_NONU *      2.09+-     0.16      1.55+-     0.38   0.74+- 0.19    -1.3
IPRBZ  IPRBZU        0.91+-     0.08      1.10+-     0.32   1.21+- 0.36     0.6
N_PRBZ N_PRBZ        2.05+-     0.15      2.10+-     0.66   1.03+- 0.33     0.1
M_ETOL M_ETOL        7.43+-     0.28      9.12+-     2.75   1.23+- 0.37     0.6
P_ETOL P_ETOL        3.77+-     0.22      3.57+-     0.77   0.95+- 0.21    -0.2
BZ135M BZ135M        4.49+-     0.23      5.13+-     1.06   1.14+- 0.24     0.6
O_ETOL O_ETOL        2.96+-     0.20      3.35+-     1.08   1.13+- 0.37     0.4
BZ124M BZ124M       12.37+-     0.74     18.68+-     7.70   1.51+- 0.63     0.8
N_DEC  N_DECU *      4.77+-     0.48      2.75+-     0.61   0.58+- 0.14    -2.6
BZ123M BZ123M        4.84+-     0.48      3.49+-     1.05   0.72+- 0.23    -1.2
DETBZ1 DETBZ1        1.23+-     0.12      1.01+-     0.41   0.82+- 0.34    -0.5
DETBZ2 DETBZ2        0.00<      0.01      1.78<      1.37   0.00<  0.00     1.3
N_UNDE N_UNDE *      2.89+-     0.29      5.01+-     1.03   1.74+- 0.40     2.0
OTHER  OTHERU       84.94+-     8.49     53.62+-     7.96   0.63+- 0.11    -2.7
MTBE   MTBEU  *     31.18+-     3.12     33.40+-     4.23   1.07+- 0.17     0.4
UNID   UNIDU  *     85.34+-     8.53     85.34+-    15.71   1.00+- 0.21     0.0
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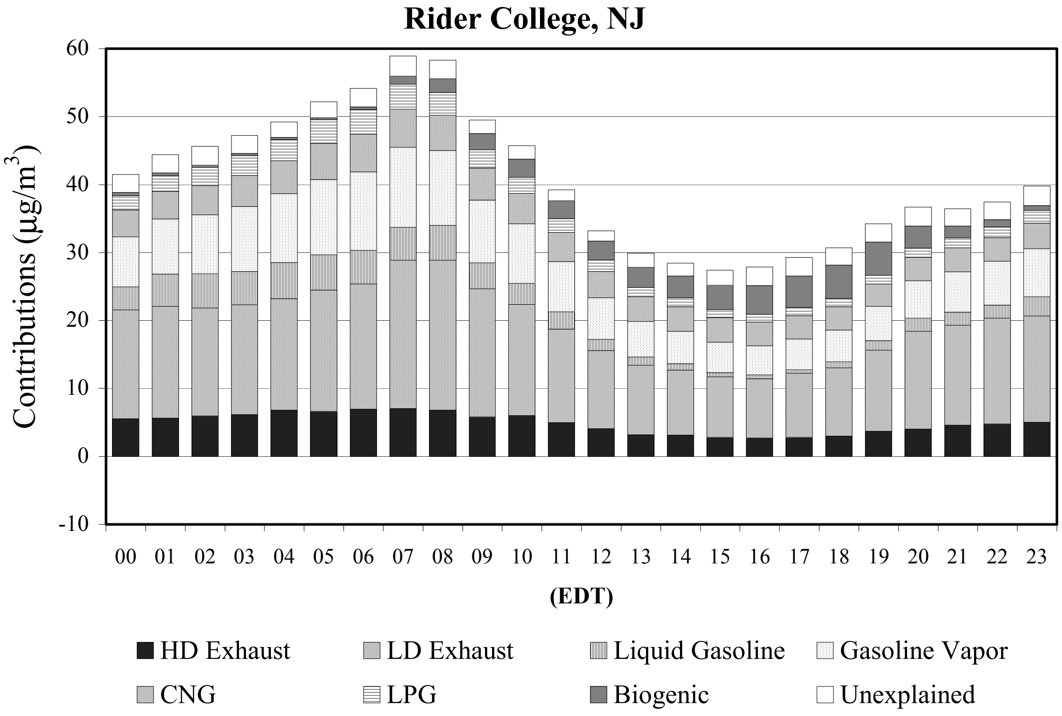


Figure 5-1. Average source contribution estimates of ambient hydrocarbons at Rider College, NJ during summer, 1995 by time of day. Source: Fujita and Lu, 1998.

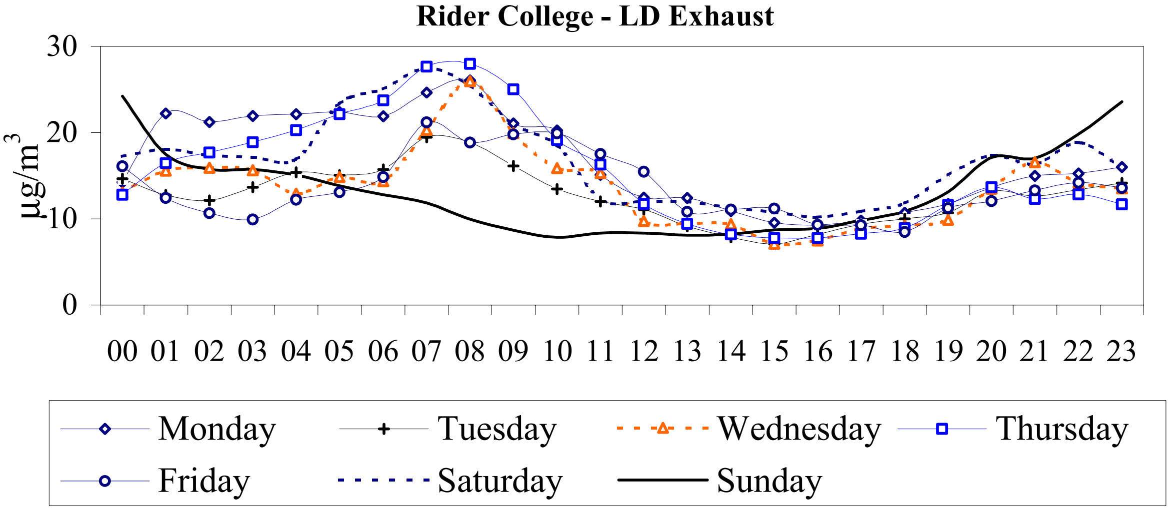
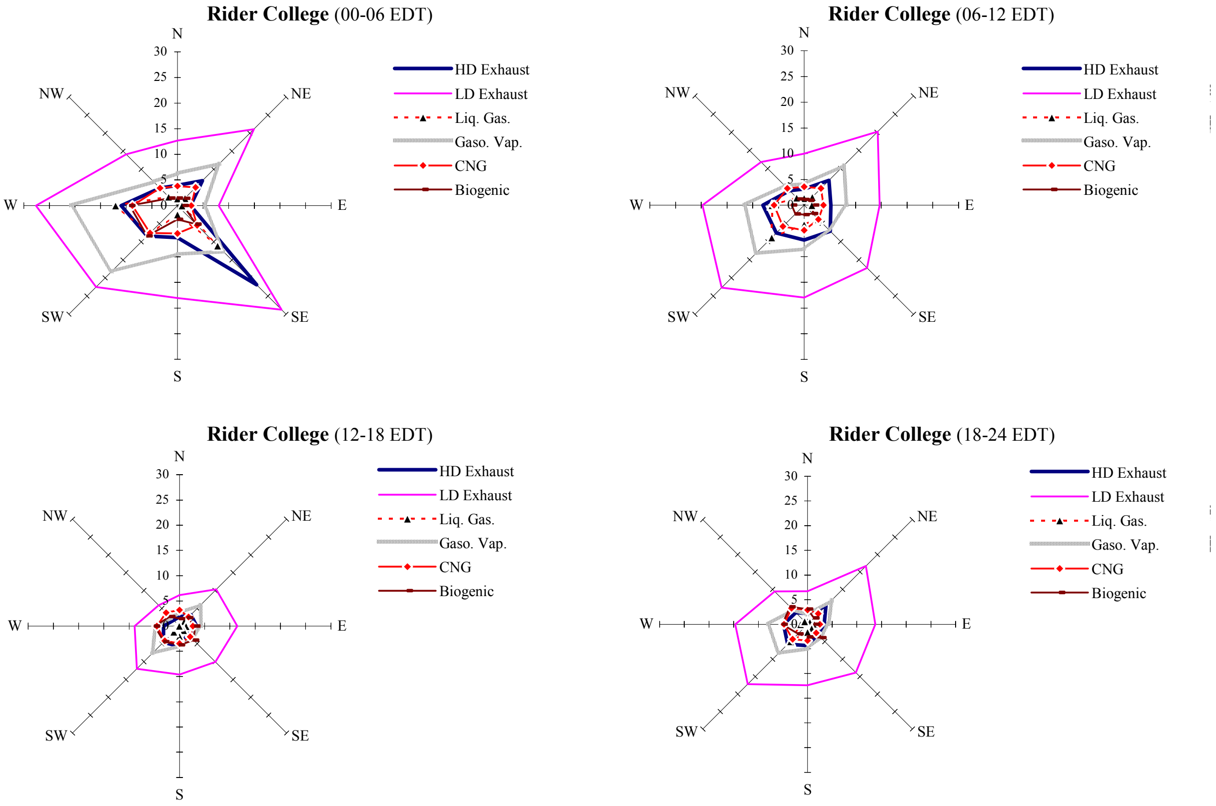


Figure 5-2. Average source contribution estimates of hydrocarbons at Rider College, NJ during summer, 1995 (EDT) by day of the week. Source: Fujita and Lu, 1998.


Rider College (00-06 EDT)

Rider College (06-12 EDT)

Rider College (12-18 EDT)

Rider College (18-24 EDT)

Figure 5-3. Wind directional dependence of source contributions by time of the day at Rider College, NJ during summer, 1995.

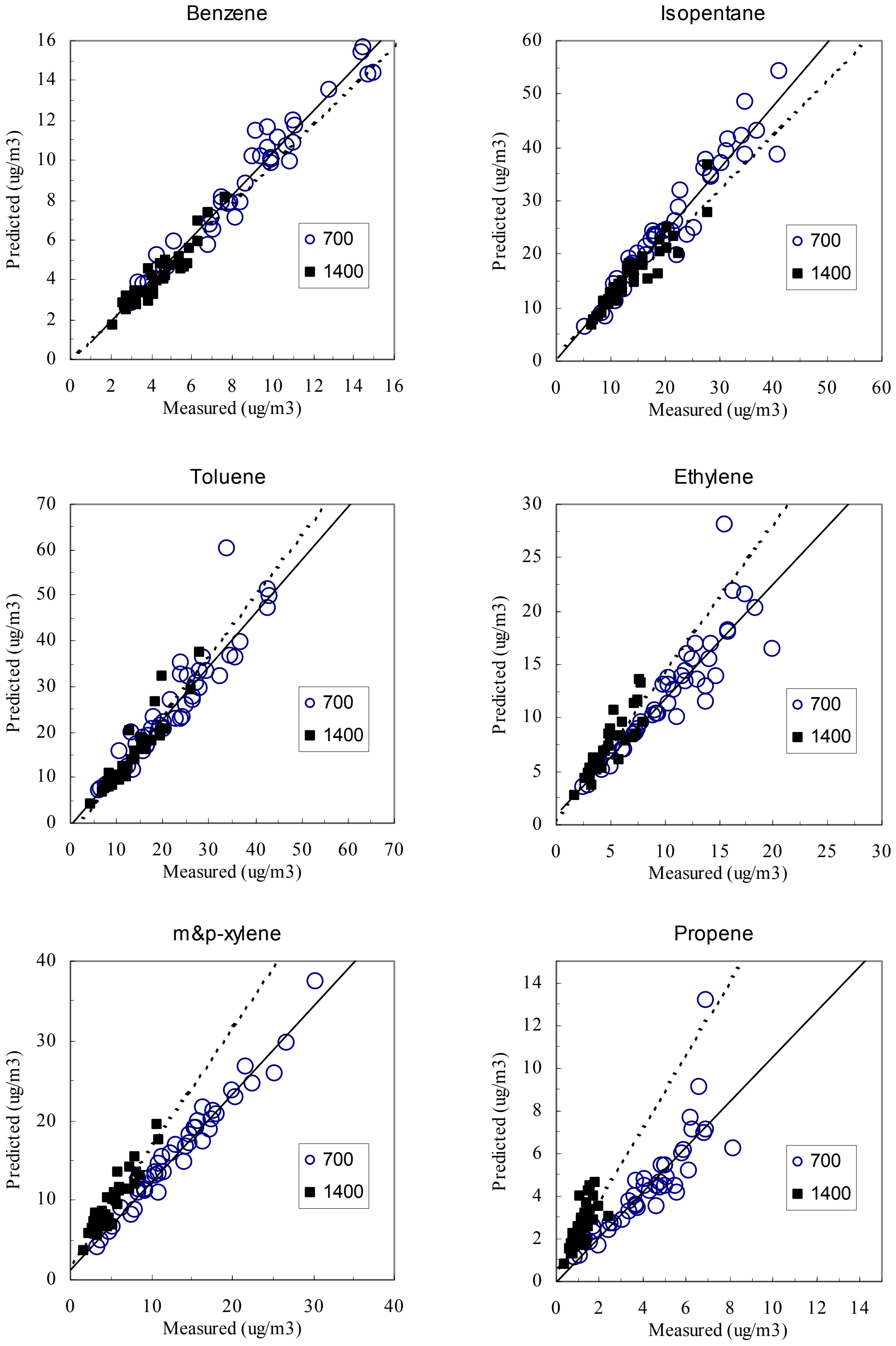


Figure 5-4. Scatterplots of Calculated Versus Measured Hydrocarbon Concentrations for samples collected at Azusa for the CARB Study.

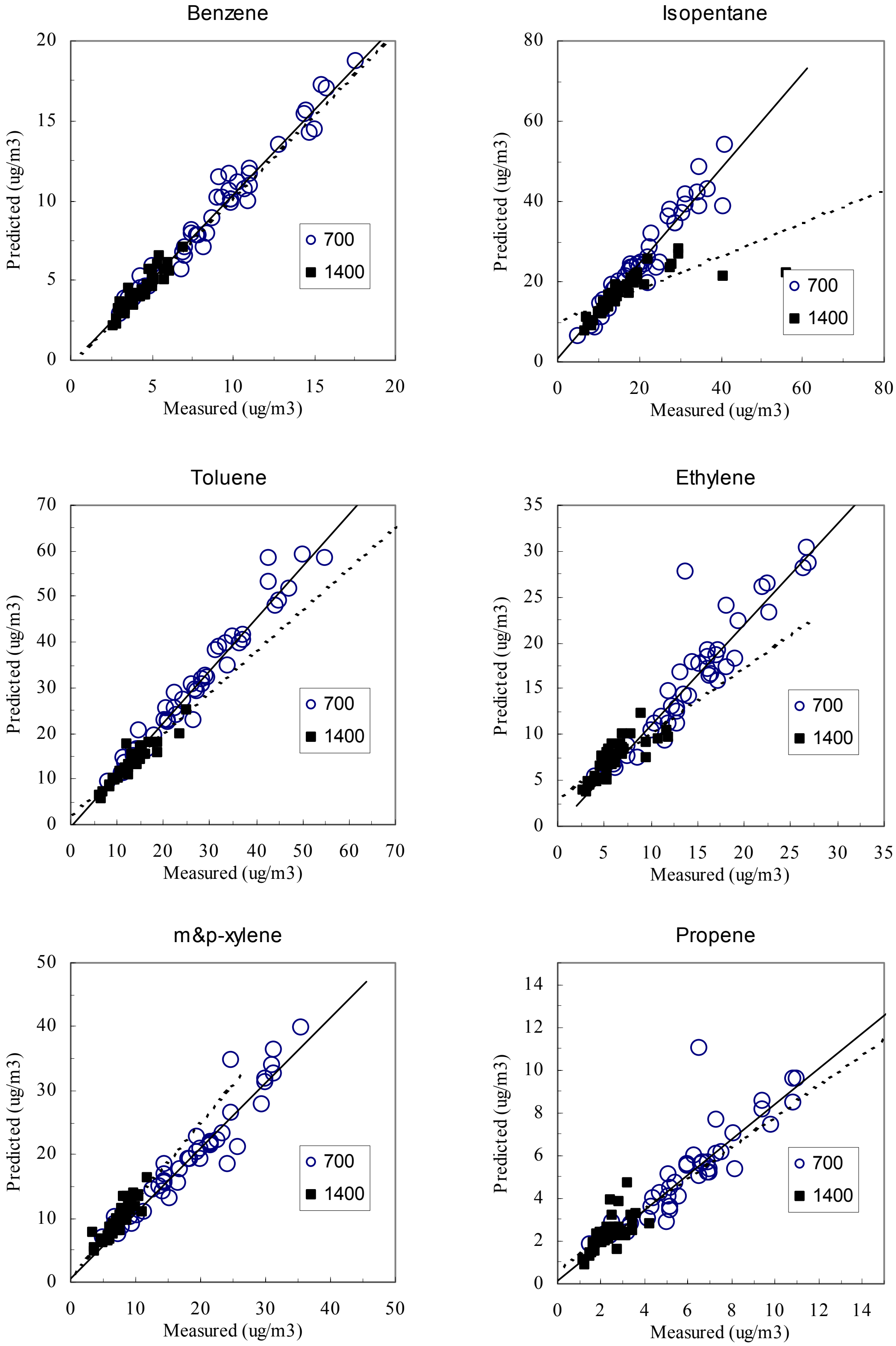


Figure 5-5. Scatterplots of Calculated Versus Measured Hydrocarbon Concentrations for samples collected at Los Angeles – North Main for the CARB Study.

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VALIDATION AND APPLICATION PROTOCOL FOR SOURCE APPORTIONMENT OF PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS) AMBIENT VOLATILE ORGANIC COMPOUUND (VOC) DATA

Appendix A

Desert Research Institute
Organic Analysis Parameter List

Appendix A
Desert Research Institute Organic Analysis Parameter List

	Mnemonic [a]			Sort Codes						Conversion			
Para #	for CMB	Compound Name	Method [b]	Data [c]	Sum [d]	PAMS [e]	CMB [f]	Formula	Units	to ug/m3 [g]	C_no	mw	Group [h]
1	PAMS	sum of PAMS species		1			G						
2	OTHER	other identified to undecane		2			G						
3	UNID	unidentified to undecane		3			G						
4	TNMHC	total NMHC to undecane		4		P00	G						
5	NMHC_p	TO14-FID identified NMHC		5				$C_1H_{1.85}$	ppbC		1	13.85	
6	UNID_p	TO14-FID unidentified		6					ppbC	0.567	1	13.85	
7	IDOXY	sum of oxygenates		7									
8	CARB	sum of carbonyls		8			G						
9	HALO	sum of halocarbons		9			G						
10	TENAX	sum of tenax >undecane		10			G						
11	METHAN	methane	c1	a001				CH_4	ppmv		1	16.04	P
12	CO_PPM	carbon monoxide	c1	a002			G	CO	ppmv	1247.900	1	28.01	
13	CO2PPM	carbon dioxide	c1	a003				CO2	ppmv	1960.732	1	44.01	
14	pdfid	TNMHC by PDFID	c5	a004	x								
15	ETHANE	ethane	c2	a005		P03	G	C_2H_6	ppbC	0.670	2	30.07	P
16	ETHENE	ethene	c2	a006		P01	G	C_2H_4	ppbC	0.625	2	28.05	O
17	ACETYL	acetylene	c2	a007		P02	G	C_2H_2	ppbC	0.580	2	26.04	Y
18	LBUT1E	1-butene	c2	a008		P07	G	C_4H_8	ppbC	0.625	4	56.11	O
19	LIBUTE	iso-butene	c2	a009			G	C_4H_8	ppbC	0.625	4	56.11	O
20	c2cmpd	sum of C2 compounds	c3	a010	x				ppbC		2		
21	PROPE	propene	c3	a011		P04	G	C_3H_6	ppbC	0.625	3	42.08	O
22	N_PROP	propane	c3	a012		P05	G	C_3H_8	ppbC	0.655	3	44.10	P
23	f12	F12 (dichlorodifluoromethane)	c3	a013	n			CF_2Cl_2	ppbC	5.387	1	120.91	X
24	mecl	methylchloride	c3	a014	n			CH_3Cl	ppbC	2.249	1	50.49	X
25	I_BUTA	isobutane	c3	a015		P06	G	C_4H_{10}	ppbC	0.647	4	58.12	P
26	f114	F114 (dichlorotetrafluoroeth)	c3	a016	n			$C_2F_4Cl_2$	ppbC	3.807	2	170.91	X
27	acetal	acetaldehyde	c3	a017	o			CH_3CHO	ppbC	0.981	2	44.05	AL
28	beabyl	1-butene + isobutylene	c3	a018	x			C4H8	ppbC	0.625	4	56.11	O
29	BUDI13	1,3-butadiene	c3	a019			G	C_4H_6	ppbC	0.602	4	54.09	O
30	N_BUTA	n-butane	c3	a020		P08	G	C_4H_{10}	ppbC	0.647	4	58.12	P
31	metoh	methanol	c3	a021	o			CH_3OH	ppbC	2.461	0.58	32.04	OH
32	T2BUTE	t-2-butene	c3	a022		P09	G	C_4H_8	ppbC	0.625	4	56.11	O
33	BUTYN	1&2-butyne	c3	a023				C_4H_6	ppbC	0.602	4	54.09	Y
34	C2BUTE	c-2-butene	c3	a024		P10	G	C_4H_8	ppbC	0.625	4	56.11	O
35	f21		c3	a025	n				ppbC	5.387	1	120.91	X
36	B1E3ME	3-methyl-1-butene	c3	a026				C_5H_{10}	ppbC	0.625	5	70.13	O
37	ETHOH	ethanol	c3	a027	o			C_2H_5OH	ppbC	1.739	1.18	46.07	OH
38	can	acetonitrile	c3	a028	n				ppbC		2	41.05	
39	propal	propionaldehyde	c3	a029	o			C_2H_5CHO	ppbC	0.863	3	58.08	AL
40	IPENTA	isopentane	c3	a030		P11	G	C_5H_{12}	ppbC	0.643	5	72.15	P
41	aceto	acetone	c3	a031	o			C_3H_6O	ppbC	0.863	3	58.08	K
42	PENTE1	1-pentene	c3	a032		P12	G	C_5H_{10}	ppbC	0.625	5	70.13	O
43	B1E2M	2-methyl-1-butene	c3	a033				C_5H_{10}	ppbC	0.625	5	70.13	O
44	N_PENT	n-pentane	c3	a034		P13	G	C_5H_{12}	ppbC	0.643	5	72.15	P
45	pr2oh	i-propanol	c3	a035	o				ppbC	0.893	3	60.10	OH
46	I_PREN	isoprene	c3	a036		P14	G	C_5H_8	ppbC	0.607	5	68.11	O
47	T2PENE	t-2-pentene	c3	a037		P15	G	C_5H_{10}	ppbC	0.625	5	70.13	O
48	C2PENE	c-2-pentene	c3	a038		P16	G	C_5H_{10}	ppbC	0.625	5	70.13	O
49	mecl2	methylene chloride	c3	a039	n			CH_2CL_2	ppbC	3.784	1	84.93	X
50	B2E2M	2-methyl-2-butene	c3	a040				C_5H_{10}	ppbC	0.625	5	70.13	O
51	tbuoh	t-butanol	c3	a041	o				ppbC	0.937	4	84.16	OH
52	f113	F113 (trichlorotrifluoroeth)	c3	a042	n			$C_2F_3Cl_3$	ppbC	4.174	2	187.38	X
53	BU22DM	2,2-dimethylbutane	c3	a043		P17	G	C_6H_{14}	ppbC	0.640	6	86.17	P
54	PRAL2M	2-methylpropanal	c3	a044	o			C_3H_7CHO	ppbC	0.803	4	72.09	AL
55	CPENTE	cyclopentene	c3	a045				C_5H_8	ppbC	0.607	5	68.11	O
56	meacro	methacrolein	c3	a046	o				ppbC	1.561	2	70.09	AL
57	P1E4ME	4-methyl-1-pentene	c3	a047				C_6H_{12}	ppbC	0.625	6	84.16	O
58	P1E3ME	3-methyl-1-pentene	c3	a048				C_6H_{12}	ppbC	0.625	6	84.16	O
59	CPENTA	cyclopentane	c3	a049		P18	G	C_5H_{10}	ppbC	0.625	5	70.13	CA
60	BU23DM	2,3-dimethylbutane	c3	a050		P19	G	C_6H_{14}	ppbC	0.640	6	86.17	P
61	MTBE	methyl-t-butylether	c3	a051			G	$C_5H_{12}O$	ppbC	0.899	4.37	88.14	E
62	PENA2M	2-methylpentane	c3	a052		P20	G	C_6H_{14}	ppbC	0.640	6	86.17	P
63	bual	butanal	c3	a053	o			C_3H_7CHO	ppbC	0.803	4	72.09	AL
64	mek buone	methyl ethyl ketone	c3	a054	o			C_4H_8O	ppbC	0.803	4	72.09	K
65	PEN22M	2,2-dimethylpentane	c3	a055				C_7H_{16}	ppbC	0.638	7	100.20	P
66	PENA3M	3-methylpentane	c3	a056		P21	G	C_6H_{14}	ppbC	0.640	6	86.17	P
67	P1E2ME	2-methyl-1-pentene	c3	a057		P22	G	C_6H_{12}	ppbC	0.625	6	84.16	O
68	HEX1E	1-hexene	c3	a058				C_6H_{12}	ppbC	0.625	6	84.16	O
69	c6ole1	C6 Olefin	c3	a059				C6H12	ppbC	0.625	6	84.16	O
70	N_HEX	n-hexane	c3	a060		P23	G	C_6H_{14}	ppbC	0.640	6	86.17	P
71	ccl3	chloroform	c3	a061	n			$CHCl_3$	ppbC	5.319	1	119.38	X
72	T3HEXE	t-3-hexene	c3	a062				C_6H_{12}	ppbC	0.625	6	84.16	O

Appendix A
Desert Research Institute Organic Analysis Parameter List

	Mnemonic [a]					Sort Codes				Conversion			
Para #	**for CMB**	**Compound Name**	**Method [b]**	**Data [c]**	**Sum [d]**	**PAMS [e]**	**CMB [f]**	**Formula**	**Units**	**to ug/m3 [g]**	**C_no**	**mw**	**Group [h]**
73	T2HEXE	t-2-hexene	c3	a063				C_6H_{12}	ppbC	0.625	6	84.16	O
74	P2E2ME	2-methyl-2-pentene	c3	a064				C_6H_{12}	ppbC	0.625	6	84.16	O
75	P2E3MC	cis-3-methyl-2-pentene	c3	a065				C_6H_{12}	ppbC	0.625	6	84.16	O
76	C3HEXE	c-3-hexene	c3	a066				C_6H_{12}	ppbC	0.625	6	84.16	O
77	C2HEXE	c-2-hexene	c3	a067				C_6H_{12}	ppbC	0.625	6	84.16	O
78	P2E3MT	trans-3-methyl-2-pentene	c3	a068				C_6H_{12}	ppbC	0.625	6	84.16	O
79	MCYPNA	methylcyclopentane	c3	a069		P24	G	C_6H_{12}	ppbC	0.625	6	84.16	P
80	PEN24M	2,4-dimethylpentane	c3	a070		P25	G	C_7H_{16}	ppbC	0.638	7	100.20	P
81	meccl3	methyl chloroform	c3	a071	n			$C_2H_3Cl_3$	ppbC	2.659	2	119.38	X
82	BU223M	2,2,3-trimethylbutane	c3	a072				C_7H_{16}	ppbC	0.638	7	100.20	P
83	CPENE1	1-methylcyclopentene	c3	a073				C_6H_7	ppbC	0.610	6	82.15	O
84	BENZE	benzene	c3	a074		P26	G	C_6H_6	ppbC	0.580	6	78.11	A
85	PEN33M	3,3-dimethylpentane	c3	a075				C_7H_{16}	ppbC	0.638	7	100.20	P
86	CYHEXA	cyclohexane	c3	a076		P27	G	C_6H_{12}	ppbC	0.625	6	84.16	CA
87	HEXE4M	4-methylhexene	c3	a077				C_7H_{16}	ppbC	0.625	7	98.19	P
88	HEXA2M	2-methylhexane	c3	a078		P28	G	C_7H_{16}	ppbC	0.638	7	100.20	P
89	PEN23M	2,3-dimethylpentane	c3	a079		P29	G	C_7H_{16}	ppbC	0.638	7	100.20	P
90	CYHEXE	cyclohexene	c3	a080				C_6H_{10}	ppbC	0.610	6	82.15	O
91	HEXA3M	3-methylhexane	c3	a081		P30	G	C_7H_{16}	ppbC	0.638	7	100.20	P
92	c7ole1	C7 olefin-1	c3	a082				C7H14	ppbC	0.625	7	98.19	O
93	CPA13M	1,3-dimethylcyclopentane	c3	a083				C_7H_{14}	ppbC	0.625	7	98.19	A
94	PA3ET	3-ethylpentane	c3	a084				C_7H_{16}	ppbC	0.558	8	100.20	P
95	hept1e	1-heptene	c3	a085					ppbC	0.625	7	98.18	O
96	PA224M	2,2,4-trimethylpentane	c3	a086		P31	G	C_8H_{18}	ppbC	0.636	8	114.23	P
97	c7ole2	C7 olefin-2	c3	a087				C7H14	ppbC	0.625	7	98.19	O
98	T3HEPE	t-3-heptene	c3	a088				C_7H_{14}	ppbC	0.625	7	98.19	O
99	N_HEPT	n-heptane	c3	a089		P32	G	C_7H_{16}	ppbC	0.638	7	100.20	P
100	c8ole1	C8 olefin-1	c3	a090				C8H16	ppbC	0.625	8	112.21	O
101	c8ole2	C8 olefin-2	c3	a091				C8H16	ppbC	0.625	8	112.21	O
102	c8ole3	C8 olefin-3	c3	a092				C8H16	ppbC	0.625	8	112.21	O
103	P1E244	2,4,4-trimethyl-1-pentene	c3	a093				C_8H_{16}	ppbC	0.625	8	112.21	O
104	MECYHX	methylcyclohexane	c3	a094		P33	G	C_7H_{14}	ppbC	0.625	7	98.19	P
105	c8pa1	C8 paraffin-1	c3	a095				C8H18	ppbC	0.636	8	114.23	P
106	HEX25M	2,5-diemthylhexane	c3	a096				C_8H_{18}	ppbC	0.636	8	114.23	P
107	HEX24M	2,4-diemthylhexane	c3	a097				C_8H_{18}	ppbC	0.636	8	114.23	P
108	c8pa2	C8 paraffin-2	c3	a098				C8H18	ppbC	0.636	8	114.23	P
109	PA234M	2,3,4-trimethylpentane	c3	a099		P34	G	C_8H_{18}	ppbC	0.636	8	114.23	P
110	TOLUE	toluene	c3	a100		P35	G	C_7H_8	ppbC	0.586	7	92.14	A
111	HX23DM	2,3-dimethylhexane	c3	a101				C_8H_{18}	ppbC	0.636	8	114.23	P
112	HEP2ME	2-methylheptane	c3	a102		P36	G	C_8H_{18}	ppbC	0.636	8	114.23	P
113	HEP4ME	4-methylheptane	c3	a103				C_8H_{18}	ppbC	0.636	8	114.23	P
114	c8pa3	C8 paraffin-3	c3	a104				C8H18	ppbC	0.636	8	114.23	P
115	HEP3ME	3-methylheptane	c3	a105		P37	G	C_8H_{18}	ppbC	0.636	8	114.23	P
116	hexal	hexanal	c3	a106	o			$C_5H_{11}CHO$	ppbC	0.744	6	100.16	AL
117	HEX225	2,2,5-trimethylhexane	c3	a107				C_9H_{20}	ppbC	0.635	9	128.26	P
118	OCT1E	octene-1	c3	a108				C_8H_{16}	ppbC	0.625	8	112.21	O
119	CHX11M	1,1-dimethylcyclohexane	c3	a109				C_8H_{16}	ppbC	0.625	8	112.21	P
120	N_OCT	n-octane	c3	a110		P38	G	C_8H_{18}	ppbC	0.636	8	114.23	P
121	HEX235	2,3,5-trimethylhexane	c3	a111				C_9H_{20}	ppbC	0.635	9	128.26	P
122	HEP24D	2,4-dimethylheptane	c3	a112				C_9H_{20}	ppbC	0.635	9	128.26	P
123	c9ole2	C9 olefin-2	c3	a113				C9H18	ppbC	0.625	9	126.24	O
124	HEP44D	4,4-dimethylheptane	c3	a114				C_9H_{20}	ppbC	0.635	9	128.26	P
125	HEP26D	2,6-dimethylheptane	c3	a115				C_9H_{20}	ppbC	0.635	9	128.26	P
126	HEP25D	2,5-dimethylheptane	c3	a116				C_9H_{20}	ppbC	0.635	9	128.26	P
127	HEP33D	3,3-dimethylheptane	c3	a117				C_9H_{20}	ppbC	0.635	9	128.26	P
128	c9ole1	C9 olefin-1	c3	a118				C9H18	ppbC	0.625	9	126.24	O
129	ETBZ	ethylbenzene	c3	a119		P39	G	C_8H_{10}	ppbC	0.591	8	106.16	A
130	c9ole3	C9 olefin-3	c3	a120				C9H18	ppbC	0.625	9	126.24	O
131	MP_XYL	m- & p-xylene	c3	a121		P40	G	C_8H_{10}	ppbC	0.591	8	106.16	A
132	OCT2ME	2-methyloctane	c3	a122				C_9H_{20}	ppbC	0.635	9	128.26	P
133	OCT3ME	3-methyloctane	c3	a123				C_9H_{20}	ppbC	0.635	9	128.26	P
134	c9par1	C9 paraffin-1	c3	a124				C9H20	ppbC	0.635	9	128.26	P
135	STYR	styrene	c3	a125		P41	G	C_8H_8	ppbC	0.580	8	104.14	A
136	O_XYL	o-xylene	c3	a126		P42	G	C_8H_{10}	ppbC	0.591	8	106.17	A
137	none1	1-nonene	c3	a127				C_9H_{18}	ppbC	0.625	9	126.24	O
138	c9par2	C9 paraffin-2	c3	a128				C9H20	ppbC	0.635	9	128.26	P
139	N_NON	n-nonane	c3	a129		P43	G	C_9H_{20}	ppbC	0.635	9	128.26	P
140	c9par3	C9 paraffin-3	c3	a130				C9H20	ppbC	0.635	9	128.26	P
141	c9ole4	C9 olefin-4	c3	a131				C9H18	ppbC	0.625	9	126.24	O
142	c9par4	C9 paraffin-4	c3	a132				C9H20	ppbC	0.635	9	128.26	P
143	IPRBZ	isopropylbenzene	c3	a133		P44	G	C_9H_{12}	ppbC	0.595	9	120.20	A
144	IPCYHX	isopropylcyclohexane	c3	a134				C_9H_{18}	ppbC	0.625	9	126.28	P

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145	benzal	benzaldehyde	c3	a135	o			C_7H_6O	ppbC	0.675	7	106.12	AL
146	OCT26D	2,6-dimethyloctane	c3	a136				$C_{10}H_{22}$	ppbC	0.634	10	142.29	P
147	A_PINE	alpha-pinene	c3	a137			G	$C_{10}H_{16}$	ppbC	0.607	10	136.23	O
148	OCT36M	3,6-dimethyloctane	c3	a138				$C_{10}H_{22}$	ppbC	0.634	10	142.29	P
149	N_PRBZ	n-propylbenzene	c3	a139		P45	G	C_9H_{12}	ppbC	0.595	9	120.20	A
150	M_ETOL	m-ethyltoluene	c3	a140		P46	G	C_9H_{12}	ppbC	0.595	9	120.20	A
151	P_ETOL	p-ethyltoluene	c3	a141		P47	G	C_9H_{12}	ppbC	0.595	9	120.20	A
152	BZ135M	1,3,5-trimethylbenzene	c3	a142		P48	G	C_9H_{12}	ppbC	0.595	9	120.20	A
153	c10p_a	C10 paraffin-a	c3	a143				C10H22	ppbC	0.634	10	142.29	P
154	O_ETOL	o-ethyltoluene	c3	a144		P49	G	C_9H_{12}	ppbC	0.595	9	120.20	A
155	octal	octanal	c3	a145	o			$C_9H_{16}O$	ppbC	0.714	8	128.22	AL
156	B_PINE	beta-pinene	c3	a146			G	$C_{10}H_{16}$	ppbC	0.607	10	136.23	O
157	DEC1E	1-decene	c3	a147					ppbC	0.625	10	140.27	O
158	BZ124M	1,2,4-trimethylbenzene	c3	a148		P50	G	C_9H_{12}	ppbC	0.595	9	120.20	A
159	N_DEC	n-decane	c3	a149		P51	G	$C_{10}H_{22}$	ppbC	0.634	10	142.29	P
160	c10ar1	C10 aromatic-1	c3	a150				C10H14	ppbC	0.598	10	134.22	A
161	I_BUBZ	isobutylbenzene	c3	a151				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
162	S_BUBZ	sec-butylbenzene	c3	a152				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
163	c10ol2	C10 olefin-2	c3	a153				C10H20	ppbC	0.625	10	140.27	O
164	BZ123M	1,2,3-trimethylbenzene	c3	a154		P52	G	C_9H_{12}	ppbC	0.595	9	120.20	A
165	c10p_c	C10 paraffin-c	c3	a155				C10H22	ppbC	0.634	10	142.29	P
166	LIMON	limonene	c3	a156			G	$C_{10}H_{16}$	ppbC	0.607	10	136.23	O
167	indan	indan	c3	a157				C_9H_{10}	ppbC	0.585	9	118.17	A
168	indene	indene	c3	a158				C_9HC_8	ppbC	0.575	9	116.15	A
169	DETBZ1	1,3-diethylbenzene	c3	a159		P53	G	$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
170	c10ar2	C10 aromatic-2	c3	a160				C10H14	ppbC	0.598	10	134.22	A
171	DETBZ2	1,4-diethylbenzene	c3	a161		P54	G	$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
172	N_BUBZ	n-butylbenzene	c3	a162				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
173	DETBZ3	1,2-diethylbenzene	c3	a163				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
174	c10ar3	C10 aromatic-3	c3	a164				C10H14	ppbC	0.598	10	134.22	A
175	BZDME	1,3-dimethyl-4-ethylbenzene	c3	a165				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
176	c10ar4	C10 aromatic-4	c3	a166				C10H14	ppbC	0.598	10	134.22	A
177	c10ar5	C10 aromatic-5	c3	a167				C10H14	ppbC	0.598	10	134.22	A
178	IPRTOL	isopropyltoluene	c3	a168				$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
179	nonal	nonanal	c3	a169	o			$C_9H_{18}O$	ppbC	0.704	9	142.24	AL
180	UNDE1E	1-undecene	c3	a170					ppbC	0.625	11	154.30	O
181	N_UNDE	n-undecane	c3	a171		P55	G	$C_{11}H_{24}$	ppbC	0.633	11	156.30	P
182	c10ar6	C10 aromatic-6	c3	aa172	z			C10H14	ppbC	0.598	10	134.22	A
183	c11p_a	C11 paraffin-a	c3	aa173	z				ppbC	0.600	11	148.25	P
184	bz1245	1,2,4,5-tetramethylbenzene	c3	aa174	z			$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
185	bz1235	1,2,3,5-tetramethylbenzene	c3	aa175	z			$C_{10}H_{14}$	ppbC		10	134.22	A
186	bz1234	1,2,3,4-tetramethylbenzene	c3	aa176	z			$C_{10}H_{14}$	ppbC	0.598	10	134.22	A
187	ind_2m	2-methylindan	c3	aa177	z			$C_{10}H_{12}$	ppbC	0.589	10	132.21	A
188	ind_1m	1-methylindan	c3	aa178	z			$C_{10}H_{12}$	ppbC	0.589	10	132.21	A
189	c11ar1	c11 aromatic-1	c3	aa179	z				ppbC	0.600	11	148.25	A
190	c11ar3	c11 aromatic-3	c3	aa180	z				ppbC	0.600	11	148.25	A
191	dode1e	1-dodecene	c3	aa181	z			$C_{12}H_{24}$	ppbC	0.632	12	170.34	O
192	naphth	naphthalene	c3	aa182	z			$C_{10}H_8$	ppbC	0.571	10	128.16	A
193	n_dode	n-dodecane	c3	aa183	z			$C_{12}H_{26}$	ppbC	0.528	12	142.29	P
194	idnmhc	idnmhc, canister/FID	c3	aaa184					ppbC				
195	unid	unidentified canister/GC-FID	c3	aaa185									
196	idoxy	id oxygenates, canister/FID	c3	aaa186					ppbC				
197	idothr	id others, canister/FID	c3	aaa187					ppbC				
198	etbz	ethylbenzene	t	t001					ug/m3		8	106.17	A
199	mp_xyl	m&p-xylene	t	t002				C_8H_{10}	ug/m3		8	106.17	A
200	cyheone	cyclohexanone	t	t003					ug/m3		6	98.15	K
201	meoct2	2-methyloctane	t	t004					ug/m3		9	120.20	P
202	heptone	2-heptanone	t	t005					ug/m3		7	114.19	K
203	oct3me	3-methyloctane	t	t006				C_9H_{20}	ug/m3		9	128.26	P
204	styr	styrene	t	t007		P41		C_8H_8	ug/m3		8	104.15	A
205	hepal	heptanal	t	t008					ug/m3		7	114.19	AL
206	o_xyl	o-xylene	t	t009		p42		C_8H_{10}	ug/m3		8	106.17	A
207	none1	1-nonene	t	t010				C_9H_{18}	ug/m3		9	126.24	O
208	n_non	nonane	t	t011				C_9H_{20}	ug/m3		9	128.26	P
209	iprbz	isopropylbenzene	t	t012		p44	G	C_9H_{12}	ug/m3		9	120.20	A
210	prcyhex	propylcyclohexane	t	t013					ug/m3		9	126.24	P
211	hepenal	t-2-heptenal	t	t014					ug/m3		7	112.17	AL
212	benzal	benzaldehyde	t	t015				C_7H_6O	ug/m3		7	106.12	AL
213	a_pine	alpha-Pinene	t	t016				$C_{10}H_{16}$	ug/m3		10	136.24	O
214	dmoct	dimethyloctane	t	t017					ug/m3		10	142.28	P
215	n_prbz	propylbenzene	t	t018		p45		C_9H_{12}	ug/m3		9	120.20	A
216	bznit	benzonitrile	t	t019					ug/m3		7	103.12	7
217	m_etol	m-ethyltoluene	t	t020					ug/m3		9	120.00	A

Appendix A
Desert Research Institute Organic Analysis Parameter List

	Mnemonic [a]				Sort Codes					Conversion			
Para #	**for CMB**	**Compound Name**	**Method [b]**	**Data [c]**	**Sum [d]**	**PAMS [e]**	**CMB [f]**	**Formula**	**Units**	**to ug/m3 [g]**	**C_no**	**mw**	**Group [h]**
218	p_etol	p-ethyltoluene	t	t021				C_9H_{12}	ug/m3		9	120.20	A
219	bz135m	1,3,5-trimethylbenzene	t	t022				C_9H_{12}	ug/m3		9	120.20	A
220	PHENOL	phenol	t	t023					ug/m3		6	94.11	A
221	o_etol	o-ethyltoluene	t	t024		p49		C_9H_{12}	ug/m3		9	120.00	A
222	b_pine	beta-pinene	t	t025				$C_{10}H_{16}$	ug/m3		10	136.24	O
223	FURBZ	2,3-benzofuran	t	t026					ug/m3		8	118.14	K
224	FURPEN	2-pentylfuran	t	t027					ug/m3		9	138.21	A
225	t_bubz	t-butylbenzene	t	t028					ug/m3		10	134.22	A
226	OCTAL	octanal	t	t029			G	$C_9H_{16}O$	ug/m3		8	128.22	A
227	bz124m	1,2,4-trimethylbenzene	t	t030				C_9H_{12}	ug/m3		9	120.20	A
228	MESTYR	4-methylstyrene	t	t031					ug/m3		9	118.18	A
229	mpcbz	1,3-dichlorobenzene	t	t032					ug/m3		6	146.00	X
230	dec1e	1-decene	t	t033					ug/m3		10	140.27	O
231	i_bubz	isobutylbenzene	t	t034				$C_{10}H_{14}$	ug/m3		10	134.22	A
232	n_dec	decane	t	t035				$C_{10}H_{22}$	ug/m3		10	142.29	P
233	s_bubz	sec-butylbenzene	t	t036				$C_{10}H_{14}$	ug/m3		10	134.22	A
234	bz123m	1,2,3-trimethylbenzene	t	t037				C_9H_{12}	ug/m3		9	120.20	A
235	m_iprtol	m-isopropyltoluene	t	t038					ug/m3		10	134.22	A
236	p_iprtol	p-isopropyltoluene	t	t039					ug/m3		10	134.22	A
237	odcbz	1,2-dichlorobenzene	t	t040				$C_6H_4Cl_2$	ug/m3		6	146.00	X
238	INDAN	indan	t	t041				C_9H_{10}	ug/m3		9	118.18	A
239	limon	(+/-)-limonene	t	t042				$C_{10}H_{16}$	ug/m3		10	136.24	O
240	INDENE	indene	t	t043					ug/m3		9	116.00	A
241	o_iprtol	o-isopropyltoluene	t	t044					ug/m3		10	134.22	A
242	O_MEPHOL	o-methylphenol	t	t045					ug/m3		7	108.00	A
243	detbz1	1,3-diethylbenzene	t	t046		P53			ug/m3		10	134.22	A
244	ACPHONE	Acetophenone	t	t047					ug/m3		8	120.15	K
245	M_TOLALD	m-tolualdehyde	t	t048					ug/m3		8	120.00	AL
246	tol4pr	4-n-propyltoluene + 1,4-diethylbenz	t	t049					ug/m3		10	134.22	A
247	butbz	Butylbenzene	t	t050				C4H6	ug/m3		10	134.22	A
248	m_xylet5	5-ethyl-m-xylene	t	t051					ug/m3		10	134.22	A
249	detbz3	1,2-diethylbenzene	t	t052					ug/m3		10	134.22	A
250	MP_MEPHO	m/p-methylphenol	t	t053					ug/m3		7	108.14	A
251	tol2pr	2-n-propyltoluene	t	t054					ug/m3		10	134.22	A
252	guacol	guaiacol	t	t055					ug/m3		7	124.14	K
253	p_xylet2	2-ethyl-p-xylene	t	t056					ug/m3		10	134.22	A
254	o_xylet4	4-ethyl-o-xylene	t	t057					ug/m3		10	134.22	A
255	tbutol_4	4-tert-butyltoluene	t	t058					ug/m3		11	148.24	A
256	NONAL	nonanal	t	t059			G	$C_9H_{18}O$	ug/m3		9	142.24	AL
257	unde1e	1-undecene	t	t060					ug/m3		11	154.30	O
258	fubz2me	2-methylbenzofuran	t	t061					ug/m3		9	132.13	K
259	n_unde	undecane	t	t062				$C_{11}H_{24}$	ug/m3		11	156.31	P
260	IPRXYL_5	5-isopropyl-m-xylene	t	t063					ug/m3		11	148.24	A
261	BZ1245	1,2,4,5-tetramethylbenzene	t	t064				$C_{10}H_{14}$	ug/m3		10	134.22	A
262	BZ1235	1,2,3,5-tetramethylbenzene	t	t065				$C_{10}H_{14}$	ug/m3		10	134.22	A
263	IAMBZ	isoamylbenzene	t	t066					ug/m3		11	148.24	A
264	IND_2M	2-methylindan	t	t067				$C_{10}H_{12}$	ug/m3		10	132.21	A
265	IND_1M	1-methylindan	t	t068				$C_{10}H_{12}$	ug/m3		10	132.21	A
266	BZ1234	1,2,3,4-tetramethylbenzene	t	t069				$C_{10}H_{14}$	ug/m3		10	134.22	A
267	DIPRB_13	1,3-diisopropylbenzene	t	t070					ug/m3		12	162.28	A
268	C5BZ_3	Pentylbenzene	t	t071					ug/m3		11	148.25	A
269	THNAPH	1,2,3,4-tetrahydronaphthalene	t	t072					ug/m3		10	132.21	A
270	DHNAPH	1,2-dihydronaphthalene	t	t073					ug/m3		10	130.19	A
271	DIPRB_14	1,4-diisopropylbenzene	t	t074					ug/m3		12	162.28	A
272	NAPHTH	naphthalene	t	t075			G	$C_{10}H_8$	ug/m3		10	128.16	A
273	INDDMA	A-dimethylindane	t	t076				C11H14	ug/m3		11	146.23	A
274	INDDMB	B-dimethylindane	t	t077				C11H14	ug/m3		11	146.23	A
275	INDDMC	C-dimethylindane	t	t078				C11H14	ug/m3		11	146.23	A
276	INDDMD	D-dimethylindan	t	t079				C11H14	ug/m3		11	146.23	A
277	DECONE2	2-decanone	t	t080					ug/m3		12	156.27	K
278	DECAL	decanal	t	t081					ug/m3		10	156.27	AL
279	DODE1E	dodecene	t	t082				$C_{12}H_{24}$	ug/m3		12	170.34	O
280	N_DODE	dodecane	t	t083			G	$C_{12}H_{26}$	ug/m3		12	142.29	P
281	PMEBZ	pentamethylbenzene	t	t084					ug/m3		11	148.25	A
282	NAP_2M	2-methylnaphthalene	t	t085			G	$C_{11}H_{10}$	ug/m3		11	142.20	A
283	NAP_1M	1-methylnaphthalene	t	t086			G	$C_{11}H_{10}$	ug/m3		11	142.20	A
284	N_TRID	tridecane	t	t087			G	$C_{13}H_{28}$	ug/m3		13	184.37	P
285	GNONLA	g-nonanoic lactone	t	t088					ug/m3		9	156.23	K
286	EUGOL	eugenol	t	t089					ug/m3		10	164.20	K
287	BIPHEN	Biphenyl	t	t090					ug/m3		12	154.21	A
288	ENAP12	1+2-ethylnaphthalene	t	t091					ug/m3		12	156.23	A
289	DMN267	2,6+2,7-dimethylnaphthalene	t	t092					ug/m3		12	156.23	A
290	N_TETD	tetradecane	t	t093			G	$C_{14}H_{30}$	ug/m3		14	198.40	P
291	DM1367	1,6+1,3+1,7-dimethylnaphthalene	t	t094					ug/m3		12	156.23	A
292	D14523	2,3+1,5+1,4-dimethylnaphthalene	t	t095					ug/m3		12	156.23	A
293	ISOEUG	isoeugenol	t	t096					ug/m3		10	164.20	K
294	ACENAP	Acenaphthylene	t	t097				$C_{12}H_8$	ug/m3		12	152.20	A

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295	gdecla	g-decanolactone	t	t098					ug/m3		10	170.25	L
296	DMN12	1,2-dimethylnaphthalene	t	t099					ug/m3		12	156.23	A
297	ACENPE	Acenaphthene	t	t100				$C_{12}H_{10}$	ug/m3		12	154.21	A
298	N_PEND	pentadecane	t	t101			G	$C_{15}H_{32}$	ug/m3		15	212.42	P
299	UNGLAC	Undecanoic-g-lactone	t	t102					ug/m3		11	184.28	K
300	FLUORE	Fluorene	t	t103					ug/m3		13	166.22	A
301	N_HEXD	Hexadecane	t	t104			G	$C_{16}H_{34}$	ug/m3		16	226.45	P
302	N_HEPD	heptadecane	t	t105			G	$C_{17}H_{36}$	ug/m3		17	240.48	P
303	PHENA	phenanthrene	t	t106				$C_{14}H_{10}$	ug/m3		14	178.23	A
304	N_OCTD	octadecane	t	t107			G	$C_{18}H_{38}$	ug/m3		18	254.50	P
305	N_NOND	nonadecane	t	t108			G	$C_{19}H_{40}$	ug/m3		19	268.53	P
306	N_EICO	eicosane	t	t109			G	$C_{20}H_{42}$	ug/m3		20	282.56	P
307	gcapla	caprolactone	t	t110					ug/m3		6	114.14	L
308	tidnmhc	id NMHC by tenax/GC-FID	t	t111					ug/m3				
309	tunid	unidentified tenax/GC-FID	t	t112					ug/m3				
310	t_bkg		t	t113					ug/m3				
311	tidothr	id others by tenax/GC-FID	t	t114					ug/m3				
312	FORMAL	formaldehyde	d	d01			G	HCHO	ppbv	1.472	1	33.03	AL
313	ACETAL	acetaldehyde	d	d02			G	CH_3CHO	ppbv	1.963	2	44.05	AL
314	ACETO	acetone	d	d03			G	C_3H_6O	ppbv	2.588	3	58.08	K
315	ACROLN	acrolein	d	d04				C_3H_4O	ppbv	2.498	3	56.07	AL
316	PROAL	propionaldehyde	d	d05			G	C_2H_5CHO	ppbv	2.588	3	58.08	AL
317	CROTON	crotonaldehyde	d	d06				C_3H_5CHO	ppbv	3.123	4	70.09	AL
318	MEK	methyl ethyl ketone	d	d07			G	C_4H_8O	ppbv	3.212	4	72.09	K
319	acrolx	acrolein-X	d	d08							3		
320	MEACRO	methacrolein	d	d09			G	C_4H_5CHO	ppbv	3.123	2	70.09	AL
321	BUAL	butanal	d	d10			G	C_3H_7CHO	ppbv	3.212	4	72.09	AL
322	BENZAL	benzaldehyde	d	d11			G	C_7H_6O	ppbv	4.728	7	106.13	AL
323	glyoxl	glyoxal	d	d12				OCHCHO	ppbv	2.586	2	58.04	AL
324	VALAL	valeraldehyde	d	d13				C_4H_9CHO	ppbv	3.838	5	86.14	AL
325	TOLUAL	tolualdehyde	d	d14				C_8H_8O	ppbv	5.353	8	120.16	AL
326	HEXAL	hexanal	d	d15			G	$C_5H_{11}CHO$	ppbv	4.462	6	100.16	AL
327	F12	F12 (dichlorodifluoromethane)	c4	e01				CF_2Cl_2	ppbv	5.387	1	120.91	X
328	F114	F114 (dichlorotetrafluoroeth)	c4	e02				$C_2F_4Cl_2$	ppbv	7.614	1	170.91	X
329	MEBR	methylbromide	c4	e03				CH_3BR	ppbv	4.230	1	94.94	X
330	F11	F11 (trichlorofluoromethane)	c4	e04				$CFCl_3$	ppbv	6.120	1	137.37	X
331	VINECL	vinylidenechloride	c4	e05				$C_2H_2Cl_2$	ppbv	4.319	2	96.94	X
332	MECL2	methylene chloride	c4	e06			G	CH_2CL_2	ppbv	3.784	1	84.93	X
333	F113	F113 (trichlorotrifluoroeth)	c4	e07				$C_2F_3Cl_3$	ppbv	8.348	2	187.38	X
334	T12DCE	trans-1,2-dichloroethylene	c4	e08				$C_2H_2Cl_2$	ppbv	4.319	2	96.94	X
335	C12DCE	cis-1,2,-dichloroethylene	c4	e09				$C_2H_2Cl_2$	ppbv	4.319	1	96.94	X
336	CCL3	chloroform	c4	e10				$CHCl_3$	ppbv	5.319	1	119.38	X
337	ETDC12	1,2-dichloroethane	c4	e11				$C_2H_4Cl_2$	ppbv	4.409	2	98.96	X
338	MECCL3	methyl chloroform	c4	e12			G	$C_2H_3Cl_3$	ppbv	5.319	2	119.38	X
339	CCL4	carbon tetrachloride	c4	e13				CCl_4	ppbv	6.853	1	153.82	X
340	DBRME	dibromomethane	c4	e14				CH_2Br_2	ppbv	7.745	1	173.85	X
341	TCENE	trichloroethylene	c4	e15				$C_2H_3Cl_3$	ppbv	5.854	2	131.39	X
342	T13DCP	trans-1,3-dichloropropene	c4	e16					ppbv	4.944	3	110.97	X
343	C13DCP	cis-1,3-dichloropropene	c4	e17				$C_3H_4Cl_2$	ppbv	4.944	3	110.97	X
344	TCE112	1,1,2-trichloroethane	c4	e18				$C_2H_3Cl_3$	ppbv	5.944	2	133.41	X
345	CLDBRM	chlorodibromomethane	c4	e19				$CHClBr_2$	ppbv	9.279	1	208.28	X
346	ETDB12	1,2-dibromoethane	c4	e20				$C_2H_4Br_2$	ppbv	8.370	2	187.87	X
347	PERC	perchloroethylene (tetra)	c4	e21			G	C_2Cl_4	ppbv	7.388	2	165.83	X
348	CLBZ	chlorobenzene	c4	e22				C_6H_5Cl	ppbv	5.014	6	112.55	X
349	TCLETH	1,1,2,2-tetrachloroethane	c4	e23				C_2HCl_3	ppbv	7.478	2	167.85	X
350	MDCBZ	m-dichlorobenzene	c4	e24				$C_6H_4Cl_2$	ppbv	6.549	6	147.00	X
351	PDCBZ	p-dichlorobenzene	c4	e25				$C_6H_4Cl_2$	ppbv	6.549	6	147.00	X
352	ODCBZ	o-dichlorobenzene	c4	e26				$C_6H_4Cl_2$	ppbv	6.549	6	147.00	X
353	I_BUTA	i-butane/methanol	g1	g001		p06	G	C_4H_{10}	wt%		4	58.12	P
354	BUT1E	Butene-1	g1	g002		p07	G	C4H8	wt%		4	56.11	O
355	N_BUTA	n-Butane	g1	g003		p08	G	C_4H_{10}	wt%		4	58.12	P
356	T2BUTE	t-butene-2	g1	g004		p09	G	C_4H_8	wt%		4	56.11	O
357	PR22M	2,2-dimethylpropane	g1	g005				C5H12	wt%		5	72.15	P
358	C2BUTE	c-Butene-2	g1	g006		p10	G	C4H8	wt%		4	56.11	O
359	ETHOH	ethanol	g1	g007				C_2H_5OH	wt%		2	46.07	OH
360	BUDI12	1,2-Butadiene	g1	g008				C4H6	wt%		4	54.09	O
361	B1E3ME	3-Methylbutene-1	g1	g009				C_5H_{10}	wt%		5	70.14	O
362	C5O1	C5 Olefin	g1	g010				C5H10	wt%		5	70.14	O
363	C5O2	C5 Olefin	g1	g011				C5H10	wt%		5	70.14	O
364	IPENTA	i-pentane	g1	g012		p11	G	C_5H_{12}	wt%		5	72.15	P
365	PENI14	1,4-pentadiene	g1	g013				C5H8	wt%		5	68.12	O
366	PR2OH	i-propanol	g1	g014				C3H8O	wt%		3	60.10	OH
367	BUTY2	Butyne-2	g1	g015				C4H6	wt%		4	54.09	Y

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368	PENTE1	pentene-1	g1	g016		p12	G	C_5H_{10}	wt%		5	70.14	O
369	B1E2M	2-Methylbutene-1	g1	g017			G	C_5H_{10}	wt%		5	70.14	O
370	N_PENT	n-pentane	g1	g018		p13	G	C_5H_{12}	wt%		5	72.15	P
371	I_PREN	isoprene	g1	g019		p14	G	C_5H_8	wt%		5	68.12	O
372	T2PENE	t-pentene-2	g1	g020		p15	G	C_5H_{10}	wt%		5	70.14	O
373	B1E33M	3,3-Dimethylbutene-1	g1	g021				C6H12	wt%		6	84.16	O
374	TBUOL	t-butanol	g1	g022				C4H10O	wt%		4	74.12	OH
375	C2PENE	c-Pentene-2	g1	g023		p16	G	C5H10	wt%		5	70.14	O
376	B2E2M	2-Methylbutene-2	g1	g024			G	C_5H_{10}	wt%		5	70.14	O
377	P1T3DI	1t,3-pentadiene	g1	g025				C5H8	wt%		5	68.12	O
378	B12DI3M	3-Methylbutadiene-1,2	g1	g026				C5H6	wt%		5	66.10	O
379	CYPDI	Cyclopentadiene	g1	g027				C5H6	wt%		5	66.10	O
380	P1C3DI	1c,3-pentadiene	g1	g028				C5H8	wt%		5	68.12	O
381	BU22DM	2,2-Dimethylbutane	g1	g029		p17	G	C_6H_{14}	wt%		6	86.18	P
382	C5O3	C5 Olefin	g1	g030				C5H10	wt%		5	70.14	O
383	C5O4	C5 Olefin	g1	g031				C5H10	wt%		5	70.14	O
384	NPROL	n-propanol	g1	g032				C3H8O	wt%		3	60.10	OH
385	CPENTE	Cyclopentene	g1	g033				C_5H_8	wt%		5	68.12	O
386	P1E4ME	4-methylpentene-1	g1	g034				C_6H_{12}	wt%		6	84.16	O
387	P1E3ME	3-methylpentene-1	g1	g035				C_6H_{12}	wt%		6	84.16	O
388	MTBE	methyl-t-butylether	g1	g036			G	$C_5H_{12}O$	wt%		5	88.15	0
389	CPENTA	Cyclopentane	g1	g037		p18	G	C_5H_{10}	wt%		5	70.14	4
390	BU23DM	2,3-Dimethylbutane	g1	g038		p19	G	C_6H_{14}	wt%		6	86.18	P
391	PC2E4M	4-methyl-c-pentene-2	g1	g039				C6H12	wt%		6	84.16	O
392	B1E23M	2,3-Dimethylbutene-1	g1	g040				C6H12	wt%		6	84.16	O
393	PENA2M	2-methylpentane	g1	g041		p20	G	C_6H_{14}	wt%		6	86.18	P
394	PT2E4M	4-methyl-t-pentene-2	g1	g042				C6H12	wt%		6	84.16	O
395	C6O1	C6 Olefin	g1	g043				C6H12	wt%		6	84.16	O
396	P14DI2M	2-methyl-1,4-pentadiene	g1	g044				C6H10	wt%		6	82.15	O
397	HEX15DI	1,5-hexadiene	g1	g045				C6H10	wt%		6	82.15	O
398	PENA3M	3-methylpentane	g1	g046		p21	G	C_6H_{14}	wt%		6	86.18	P
399	P1E2ME	2-methylpentene-1	g1	g047		p22	G	C_6H_{12}	wt%		6	84.16	O
400	HEX1E	hexene-1	g1	g048				C_6H_{12}	wt%		6	84.16	O
401	C6O2	C6 Olefin	g1	g049				C6H12	wt%		6	84.16	O
402	HXCT14DI	1c/t,4-hexadiene	g1	g050				C6H10	wt%		6	82.15	O
403	B1E2E	2-Ethylbutene-1	g1	g051				C6H12	wt%		6	84.16	O
404	N_HEX	n-hexane	g1	g052		p23	G	C_6H_{14}	wt%		6	86.18	P
405	T3HEXE	t-hexene-3	g1	g053				C_6H_{12}	wt%		6	84.16	O
406	T2HEXE	t-hexene-2	g1	g054				C_6H_{12}	wt%		6	84.16	O
407	P2E2ME	2-methylpentene-2	g1	g055			G	C_6H_{12}	wt%		6	84.16	O
408	CPENE1	Methylcyclopentene	g1	g056			G	C6H10	wt%		6	82.15	O
409	PC2E3M	3-methyl-c-pentene-2	g1	g057				C_6H_{12}	wt%		6	84.16	O
410	C6O3	C6 Olefin	g1	g058				C6H12	wt%		6	84.16	O
411	C3HEXE	c-Hexene-3	g1	g059				C_6H_{12}	wt%		6	84.16	O
412	C2HEXE	c-Hexene-2	g1	g060				C_6H_{12}	wt%		6	84.16	O
413	C6O4	C6 Olefin	g1	g061				C6H12	wt%		6	84.16	O
414	ETBE	ethyl-t-butylether	g1	g062				C6H14O	wt%		6	102.18	E
415	P1E33M	3,3-dimethylpentene-1	g1	g063				C7H14	wt%		7	98.19	O
416	PT2E3M	3-methyl-t-pentene-2	g1	g064			G	C_6H_{12}	wt%		6	84.16	O
417	HXCT13DI	1c/t,3-hexadiene	g1	g065				C6H10	wt%		6	82.15	O
418	PT2E22M	4,4-dimethyl-t-pentene-2	g1	g066				C7H14	wt%		7	98.19	O
419	PEN22M	2,2-dimethylpentane	g1	g067				C_7H_{16}	wt%		7	100.21	P
420	MCYPNA	methylcyclopentane	g1	g068		p24	G	C_6H_{12}	wt%		6	84.16	CA
421	PEN24M	2,4-dimethylpentane	g1	g069		p25	G	C_7H_{16}	wt%		7	100.21	P
422	B1E233M	2,3,3-Trimethylbutene-1	g1	g070				C7H14	wt%		7	98.19	O
423	C7O1	C7 Olefin	g1	g071				C7H14	wt%		7	98.19	O
424	BU223M	2,2,3-Trimethylbutane	g1	g072				C_7H_{16}	wt%		7	100.21	P
425	C7O2	C7 Olefin	g1	g073				C7H14	wt%		7	98.19	O
426	C7O3	C7 Olefin	g1	g074				C7H14	wt%		7	98.19	O
427	P1E34M	3,4-dimethylpentene-1	g1	g075				C7H14	wt%		7	98.19	O
428	PC2E44M	4,4-dimethyl-c-pentene-2	g1	g076				C7H14	wt%		7	98.19	O
429	P1E24M	2,4-dimethylpentene-1	g1	g077				C7H14	wt%		7	98.19	O
430	C6O5	C6 Olefin	g1	g078				C6H12	wt%		6	84.16	O
431	MECYP1E	1-methylcyclopentene	g1	g079			G	C6H10	wt%		6	82.15	O
432	BENZE	Benzene	g1	g080		p26	G	C_6H_6	wt%		6	78.11	A
433	P1E3E	3-ethylpentene-1	g1	g081				C7H14	wt%		7	98.19	O
434	NBUOL	n-butanol	g1	g082				C4H10O	wt%		4	74.12	OH
435	HX1E3M	3-methylhexene-1	g1	g083				C7H14	wt%		7	98.19	O
436	HXC3E2M	2-methyl-c-hexene-3	g1	g084				C7H14	wt%		7	98.19	O
437	PEN33M	3,3-dimethylpentane	g1	g085				C_7H_{16}	wt%		7	100.21	P
438	HX1E5M	5-methylhexene-1	g1	g086				C7H14	wt%		7	98.19	O
439	CYHEXA	Cyclohexane	g1	g087		p27	G	C_6H_{12}	wt%		6	84.16	CA
440	HXT3E2M	2-methyl-t-hexene-3	g1	g088				C7H14	wt%		7	98.19	O
441	C6O6	C6 Olefin	g1	g089				C6H12	wt%		6	84.16	O
442	B1E2E3M	2-Ethyl-3-methylbutene-1	g1	g090				C7H14	wt%		7	98.19	O
443	HEXE4M	4-methylhexene-1	g1	g091				C7H14	wt%		7	98.19	O

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	Mnemonic [a]				Sort Codes					Conversion			
Para #	for CMB	Compound Name	Method [b]	Data [c]	Sum [d]	PAMS [e]	CMB [f]	Formula	Units	to ug/m3 [g]	C_no	mw	Group [h]
444	HXCT2E4M	4-methyl-t/c-hexene-2	g1	g092				C7H14	wt%		7	98.19	O
445	HEXA2M	2-methylhexane	g1	g093		p28	G	C_7H_{16}	wt%		7	100.21	P
446	PEN23M	2,3-dimethylpentane	g1	g094		p29	G	C_7H_{16}	wt%		7	100.21	P
447	HXT2E5M	5-methyl-t-hexene-2/TAmE	g1	g095				C7H14	wt%		7	98.19	O
448	TAME	t-amylmethylether (TAME)	g1	g096				C6H14O	wt%		6	102.18	0
449	CYPEN11M	1,1-Dimethylcyclopentane	g1	g097				C7H14	wt%		7	98.19	CA
450	CYHEXE	Cyclohexene	g1	g098				C_6H_{10}	wt%		6	82.15	O
451	HEXA3M	3-methylhexane	g1	g099		p30	G	C_7H_{16}	wt%		7	100.21	P
452	HP16DI	1,6-heptadiene	g1	g100				C7H12	wt%		7	96.17	O
453	PC2E34M	3,4-dimethyl-c-pentene-2	g1	g101				C7H14	wt%		7	98.19	O
454	HXC2E5M	5-methyl-c-hexene-2	g1	g102				C7H14	wt%		7	98.19	O
455	CYP1C3M	1c,3-Dimethylcyclopentane	g1	g103				C7H16	wt%		7	100.21	CA
456	CYP1T3M	1t,3-Dimethylcyclopentane	g1	g104				C7H16	wt%		7	100.21	CA
457	PA3ET	3-ethylpentane	g1	g105				C_7H_{16}	wt%		7	100.21	P
458	HX1E2M	2-methylhexene-1	g1	g106				C7H14	wt%		7	98.19	O
459	CYP1T2M	1t,2-Dimethylcyclopentane	g1	g107				C7H16	wt%		7	100.21	CA
460	PA224M	2,2,4-trimethylpentane	g1	g108		p31	G	C_8H_{18}	wt%		8	114.23	P
461	HEPT1E	heptene-1	g1	g109				C7H14	wt%		7	98.19	O
462	P1E2E	2-ethylpentene-1	g1	g110				C7H14	wt%		7	98.19	O
463	HP15DI	1,5-heptadiene	g1	g111				C7H12	wt%		7	96.17	O
464	C7O4	C7 Olefin	g1	g112				C7H14	wt%		7	98.19	O
465	HX3CE3M	3-methyl-c-hexene-3	g1	g113				C7H14	wt%		7	98.19	O
466	T3HEPE	t-heptene-3	g1	g114				C_7H_{14}	wt%		7	98.19	O
467	N_HEPT	n-heptane	g1	g115		p32	G	C_7H_{16}	wt%		7	100.21	P
468	HPC3E	c-heptene-3	g1	g116				C7H14	wt%		7	98.19	O
469	HX2E2M	2-methylhexene-2	g1	g117				C7H14	wt%		7	98.19	O
470	HXC2E3M	3-methyl-c-hexene-2	g1	g118				C7H14	wt%		7	98.19	O
471	HXT3E3M	3-methyl-t-hexene-3	g1	g119				C7H14	wt%		7	98.19	O
472	HPT2E	t-heptene-2	g1	g120				C7H14	wt%		7	98.19	O
473	P2E3E	3-ethylpentene-2	g1	g121				C7H14	wt%		7	98.19	O
474	HXT2E3M	3-methyl-t-hexene-2	g1	g122				C7H14	wt%		7	98.19	O
475	C7O5	C7 Olefin	g1	g123				C7H14	wt%		7	98.19	O
476	HPC2E	c-heptene-2	g1	g124				C7H14	wt%		7	98.19	O
477	P2E23M	2,3-dimethylpentene-2	g1	g125				C7H14	wt%		7	98.19	O
478	CYPE3E	3-Ethylcyclopentene	g1	g126				C7H14	wt%		7	98.19	O
479	C7O6	C7 Olefin	g1	g127				C7H14	wt%		7	98.19	O
480	CYPA1C2M	1c,2-Dimethylcyclopentane	g1	g128				C7H14	wt%		7	98.19	CA
481	MECYHX	methylcyclohexane	g1	g129		p33	G	C7H14	wt%		7	98.19	CA
482	C7O7	C7 Olefin	g1	g130				C7H14	wt%		7	98.19	O
483	CYP113M	1,1,3-Trimethylcyclopentane	g1	g131				C8H16	wt%		8	112.22	CA
484	HEX22M	2,2-dimethylhexane	g1	g132				C_8H_{18}	wt%		8	114.23	P
485	C7O8	C7 Olefin	g1	g133				C7H14	wt%		7	98.19	O
486	C7O9	C7 Olefin	g1	g134				C7H14	wt%		7	98.19	O
487	C7O10	C7 Olefin	g1	g135				C7H14	wt%		7	98.19	O
488	C7O11	C7 Olefin	g1	g136				C7H14	wt%		7	98.19	O
489	C7O12	C7 Olefin	g1	g137				C7H14	wt%		7	98.19	O
490	CYPAE	Ethylcyclopentane	g1	g138				C7H16	wt%		7	100.21	CA
491	HEX25M	2,5-dimethylhexane	g1	g139			G	C_8H_{18}	wt%		8	114.23	P
492	PA223M	2,2,3-trimethylpentane	g1	g140				C_8H_{18}	wt%		8	114.23	P
493	HEX24M	2,4-dimethylhexane	g1	g141			G	C_8H_{18}	wt%		8	114.23	P
494	C7O13	C7 Olefin	g1	g142				C7H14	wt%		7	98.19	O
495	CYP1C2T4	1c,2t,4-Trimethylcyclopentane	g1	g143				C8H16	wt%		8	112.22	CA
496	HX33M	3,3-dimethylhexane	g1	g144				C8H18	wt%		8	114.23	P
497	C7O14	C7 Olefin	g1	g145				C7H14	wt%		7	98.19	O
498	CYP1T2C3	1t,2c,3-Trimethylcyclopentane	g1	g146				C8H16	wt%		8	112.22	CA
499	C7O15	C7 Olefin	g1	g147				C7H14	wt%		7	98.19	O
500	PA234M	2,3,4-trimethylpentane	g1	g148		p34	G	C_8H_{18}	wt%		8	114.23	P
501	C7O16	C7 Olefin	g1	g149				C7H14	wt%		7	98.19	O
502	TOLUE	Toluene	g1	g150		p35	G	C_7H_8	wt%		7	92.14	A
503	P233M	2,3,3-trimethylpentane	g1	g151				C8H18	wt%		8	114.23	P
504	C8O1	C8 Olefin	g1	g152				C8H16	wt%		8	112.22	O
505	C8O2	C8 Olefin	g1	g153				C8H16	wt%		8	112.22	O
506	C8O3	C8 Olefin	g1	g154				C8H16	wt%		8	112.22	O
507	HX23DM	2,3-dimethylhexane	g1	g155				C8H18	wt%		8	114.23	P
508	P2M3E	2-methyl-3-ethylpentane	g1	g156				C8H18	wt%		8	114.23	P
509	CYP112M	1,1,2-Trimethylcyclopentane	g1	g157				C8H16	wt%		8	112.22	CA
510	C8O4	C8 Olefin	g1	g158				C8H16	wt%		8	112.22	O
511	C8O5	C8 Olefin	g1	g159				C8H16	wt%		8	112.22	O
512	C7O17	C7 Olefin	g1	g160				C7H14	wt%		7	98.19	O
513	HEP2ME	2-methylheptane	g1	g161		p36	G	C_8H_{18}	wt%		8	114.23	P
514	HX1E2E	2-ethylhexene-1	g1	g162				C8H16	wt%		8	112.22	O
515	HEP4ME	4-methylheptane	g1	g163				C8H18	wt%		8	114.23	P
516	P3M3E	3-methyl-3-ethylpentane	g1	g164				C8H18	wt%		8	114.23	P
517	HEX34M	3,4-dimethylhexane	g1	g165				C_8H_{18}	wt%		8	114.23	P
518	CYP1C2C4	1c,2c,4-Trimethylcyclopentane	g1	g166				C8H16	wt%		8	112.22	CA
519	CHX1C3M	1c,3-Dimethylcyclohexane	g1	g167				C8H16	wt%		8	112.22	CA
520	HEP3ME	3-methylheptane	g1	g168		p37	G	C_8H_{18}	wt%		8	114.23	P
521	CYP1C2T3	1c,2t,3-Trimethylcyclopentane	g1	g169				C8H116	wt%		8	112.22	CA

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Para #	**for CMB**	**Compound Name**	**Method [b]**	**Data [c]**	**Sum [d]**	**PAMS [e]**	**CMB [f]**	**Formula**	**Units**	**to ug/m3 [g]**	**C_no**	**mw**	**Group [h]**
522	HEX3E	3-ethylhexane	g1	g170				C_8H_{18}	wt%		8	114.23	P
523	CHX1T4M	1t,4-Dimethylcyclohexane	g1	g171				C8H16	wt%		8	112.22	CA
524	O13DI	1,3-octadiene	g1	g172				C8H14	wt%		8	110.20	O
525	C8O6	C8 Olefin	g1	g173				C8H16	wt%		8	112.22	O
526	CHX11M	1,1-Dimethylcyclohexane	g1	g174				C8H16	wt%		8	112.22	CA
527	HEX225	2,2,5-trimethylhexane	g1	g175				C_9H_{20}	wt%		9	128.26	P
528	CYPM3CE	3c-Ethylmethylcyclopentane	g1	g176				C8H16	wt%		8	112.22	CA
529	HP1E26M	2,6-dimethylheptene-1	g1	g177				C9H18	wt%		9	126.24	O
530	CYPM3TE	3t-Ethylmethylcyclopentane	g1	g178				C8H16	wt%		8	112.22	CA
531	OCT1E	octene-1	g1	g179				C_8H_{16}	wt%		8	112.22	O
532	CYPM2TE	2t-Ethylmethylcyclopentane	g1	g180				C8H16	wt%		8	112.22	CA
533	CYP11ME	1,1-Methylethylcyclopentane	g1	g181				C8H16	wt%		8	112.22	CA
534	HX224M	2,2,4-trimethylhexane	g1	g182				C9H20	wt%		9	128.26	P
535	CHX1T2M	1t,2-Dimethylcyclohexane	g1	g183				C8H16	wt%		8	112.22	CA
536	OCTT4E	t-octene-4	g1	g184				C8H16	wt%		8	112.22	O
537	HX1E355M	3,5,5-trimethylhexene-1	g1	g185				C9H18	wt%		9	126.24	O
538	OCTT3E	t-octene-3	g1	g186				C8H16	wt%		8	112.22	O
539	CYP1C2C3	1c,2c,3-Trimethylcyclopentane	g1	g187				C8H16	wt%		8	112.22	CA
540	CHX1T3M	1t,3-Dimethylcyclohexane	g1	g188				C8H16	wt%		8	112.22	CA
541	N_OCT	n-octane	g1	g189		p38	G	C_8H_{18}	wt%		8	114.23	P
542	CHX1C4M	1c,4-Dimethylcyclohexane	g1	g190				C8H16	wt%		8	112.22	CA
543	HP1E33M	3,3-dimethylheptene-1	g1	g191				C9H18	wt%		9	126.24	O
544	OCT2E	octene-2	g1	g192				C_8H_{16}	wt%		8	112.22	O
545	C8O7	C8 Olefin	g1	g193				C8H16	wt%		8	112.22	O
546	C9P1	C9 Paraffin	g1	g194				C9H20	wt%		9	128.26	P
547	CYPIPR	i-Propylcyclopentane	g1	g195				C8H16	wt%		8	112.22	CA
548	HX244M	2,4,4-trimethylhexane	g1	g196				C9H20	wt%		9	128.26	P
549	C9O1	C9 Olefin	g1	g197				C9H18	wt%		9	126.24	O
550	C8O8	C8 Olefin	g1	g198				C8H16	wt%		8	112.22	O
551	C8N1	C8 Naphthene	g1	g199				C8H16	wt%		8	112.22	CA
552	P2234M	2,2,3,4-tetramethylpentane	g1	g200				C9H20	wt%		9	128.26	P
553	HX234M	2,3,4-trimethylhexane	g1	g201				C9H20	wt%		9	128.26	P
554	C8N2	C8 Naphthene	g1	g202				C8H16	wt%		8	112.22	CA
555	C8N3	C8 Naphthene	g1	g203				C8H16	wt%		8	112.22	CA
556	HX1E233	2,3,3-trimethylhexene-1	g1	g204				C9H18	wt%		9	126.24	O
557	HX235	2,3,5-trimethylhexane	g1	g205				C9H20	wt%		9	128.26	P
558	CHX1C2M	1c,2-Dimethylcyclohexane	g1	g206				C8H16	wt%		8	112.22	CA
559	HEP22M	2,2-dimethylheptane	g1	g207				C_9H_{20}	wt%		9	128.26	P
560	CHX114M	1,1,4-Trimethylcyclohexane	g1	g208				C9H18	wt%		9	126.24	CA
561	HPT3E22M	t-2,2-dimethylheptene-3	g1	g209				C9H18	wt%		9	126.24	O
562	HX223M	2,2,3-trimethylhexane	g1	g210				C9H20	wt%		9	128.26	P
563	C8N4	C8 Naphthene	g1	g211				C8H16	wt%		8	112.22	CA
564	HEP24D	2,4-dimethylheptane	g1	g212				C_9H_{20}	wt%		9	128.26	P
565	HEP44D	4,4-dimethylheptane	g1	g213				C9H20	wt%		9	128.26	P
566	C8N5	C8 Naphthene	g1	g214				C8H16	wt%		8	112.22	CA
567	CHXETH	Ethylcyclohexane	g1	g215				C8H16	wt%		8	112.22	CA
568	CYPNPR	n-Propylcyclopentane	g1	g216				C8H16	wt%		8	112.22	CA
569	CHX1C3C5M	1c,3c,5-Trimethylcyclohexane	g1	g217				C9H18	wt%		9	126.24	CA
570	HEP33D	3,3-dimethylheptane	g1	g218				C_9H_{20}	wt%		9	128.26	P
571	HX2M4E	2-methyl-4-ethylhexane	g1	g219				C9H20	wt%		9	128.26	P
572	HEP26D	2,6-dimethylheptane	g1	g220				C_9H_{20}	wt%		9	128.26	P
573	C9N1	C9 Naphthene	g1	g221				C9H18	wt%		9	126.24	CA
574	CHX113M	1,1,3-Trimethylcyclohexane	g1	g222				C9H18	wt%		9	126.24	CA
575	HP1E24M	2,4-dimethyldheptene-1	g1	g223				C9H18	wt%		9	126.24	CA
576	C8N6	C8 Naphthene	g1	g224				C8H16	wt%		9	112.22	O
577	HEP25D	2,5-dimethylheptane	g1	g225				C_9H_{20}	wt%		8	128.26	P
578	C8N7	C8 Naphthene	g1	g226				C8H16	wt%		8	112.22	CA
579	C9N2	C9 Naphthene	g1	g227				C9H18	wt%		9	126.24	CA
580	ETBZ	ethylbenzene	g1	g228		p39	G	C8H10	wt%		8	106.17	A
581	C9N3	C9 Naphthene	g1	g229				C9H18	wt%		9	126.24	CA
582	CHX1C2T4T	1c,2t,4t-Trimethylcyclohexane	g1	g230				C9H18	wt%		9	126.24	CA
583	O1E2M	2-methyloctene-1	g1	g231				C9H18	wt%		9	126.24	O
584	C9P2	C9 Paraffin	g1	g232				C9H20	wt%		9	128.26	P
585	O2E2M	2-methyloctene-2	g1	g233				C9H18	wt%		9	126.24	O
586	C9N4	C9 Naphthene	g1	g234				C9H18	wt%		9	126.24	CA
587	C9N5	C9 Naphthene	g1	g235				C9H18	wt%		9	126.24	CA
588	M_XYL	m-xylene	g1	g236		p40	G	C8H10	wt%		8	106.17	A
589	P_XYL	p-xylene	g1	g237		p40	G	C8H10	wt%		8	106.17	A
590	HEP23M	2,3-dimethylheptane	g1	g238				C_9H_{20}	wt%		9	128.26	P
591	HEP34M	3,4-dimethylheptane	g1	g239				C_9H_{20}	wt%		9	128.26	P
592	HEP35M	3,5-dimethylheptane	g1	g240				C_9H_{20}	wt%		9	128.26	P
593	C9N6	C9 Naphthene	g1	g241				C9H18	wt%		9	126.24	CA
594	C9P3	C9 Paraffin	g1	g242				C9H20	wt%		9	128.26	P
595	NON1E	nonene-1	g1	g243				C9H18	wt%		9	126.24	O
596	HEP4E	4-ethylheptane	g1	g244				C9H20	wt%		9	128.26	P
597	OCT4M	4-methyloctane	g1	g245				C_9H_{20}	wt%		9	128.26	P
598	OCT2ME	2-methyloctane	g1	g246				C_9H_{20}	wt%		9	128.26	P
599	C9N7	C9 Naphthene	g1	g247				C9H18	wt%		9	126.24	CA
600	C9N8	C9 Naphthene	g1	g248				C9H18	wt%		9	126.24	CA

Appendix A
Desert Research Institute Organic Analysis Parameter List

	Mnemonic [a]				Sort Codes					Conversion			
Para #	for CMB	Compound Name	Method [b]	Data [c]	Sum [d]	PAMS [e]	CMB [f]	Formula	Units	to ug/m3 [g]	C_no	mw	Group [h]
601	HEP3E	3-ethylheptane	g1	g249				C_9H_{20}	wt%		9	128.26	P
602	OCT3ME	3-methyloctane	g1	g250				C_9H_{20}	wt%		9	128.26	P
603	PEN33E	3,3-diethylpentane	g1	g251				C9H20	wt%		9	128.26	P
604	CHX1C2T4C	1c,2t,4c-Trimethylcyclohexane	g1	g252				C9H18	wt%		9	126.24	CA
605	C9P4	C9 Paraffin	g1	g253				C9H20	wt%		9	128.26	P
606	O_XYL	o-xylene	g1	g254		p42	G	C_8H_{10}	wt%		8	106.17	A
607	CHX112	1,1,2-Trimethylcyclohexane	g1	g255				C9H18	wt%		9	126.24	CA
608	C9P5	C9 Paraffin	g1	g256				C9H20	wt%		9	128.26	P
609	C9P6	C9 Paraffin	g1	g257				C9H20	wt%		9	128.26	P
610	C9N9	C9 Naphthene	g1	g258				C9H18	wt%		9	126.24	CA
611	C9N10	C9 Naphthene	g1	g259				C9H18	wt%		9	126.24	CA
612	C9P7	C9 Paraffin	g1	g260				C9H20	wt%		9	128.26	P
613	NONT2E	t-nonene-2	g1	g261				C_9H_{18}	wt%		9	126.24	O
614	C9N11	C9 Naphthene	g1	g262				C9H18	wt%		9	126.24	CA
615	OT3E2M	t-2-methyloctene-3	g1	g263				C9H18	wt%		9	126.24	O
616	CYPIBU	i-Butylcyclopentane	g1	g264				C9H18	wt%		9	126.24	CA
617	C9N12	C9 Naphthene	g1	g265				C9H18	wt%		9	126.24	CA
618	C9N13	C9 Naphthene	g1	g266				C9H18	wt%		9	126.24	CA
619	C9N14	C9 Naphthene	g1	g267				C9H18	wt%		9	126.24	CA
620	NONC2E	c-nonene-2	g1	g268				C_9H_{18}	wt%		9	126.24	O
621	C9P8	C9 Paraffin	g1	g269				C9H20	wt%		9	128.26	P
622	HP2E23M	2,3-dimethylheptene-2	g1	g270				C9H18	wt%		9	126.24	O
623	NONT3E	t-nonene-3	g1	g271				C_9H_{18}	wt%		9	126.24	O
624	N_NON	n-nonane	g1	g272		p43	G	C_9H_{20}	wt%		9	128.26	P
625	CHX11ME	1,1-Methylethylcyclohexane	g1	g273				C9H18	wt%		9	126.24	CA
626	O1E37M	3,7-dimethyloctene-1	g1	g274				C10H20	wt%		10	140.27	O
627	C9N15	C9 Naphthene	g1	g275				C9H18	wt%		9	126.24	CA
628	HX3E2255	t-2,2,5,5-tetramethylhexene-3	g1	g276				C10H20	wt%		10	140.27	O
629	IPRBZ	i-propylbenzene	g1	g277		p44	G	C_9H_{12}	wt%		9	120.20	A
630	C9N16	C9 Naphthene	g1	g278				C9H18	wt%		9	126.24	CA
631	NONC3E	c-nonene-3	g1	g279				C_9H_{18}	wt%		9	126.24	O
632	C9N17	C9 Naphthene	g1	g280				C9H18	wt%		9	126.24	CA
633	C10P1	C10 Paraffin	g1	g281				C10H22	wt%		10	142.29	P
634	CHXIPR	i-Propylcyclohexane	g1	g282				C9H18	wt%		9	126.24	CA
635	C10P2	C10 Paraffin	g1	g283				C10H22	wt%		10	142.29	P
636	OCT22M	2,2-dimethyloctane	g1	g284				$C_{10}H_{22}$	wt%		10	142.29	P
637	OCT24M	2,4-dimethyloctane	g1	g285				$C_{10}H_{22}$	wt%		10	142.29	P
638	C9N18	C9 Naphthene	g1	g286				C9H18	wt%		9	126.24	CA
639	C9N19	C9 Naphthene	g1	g287				C9H18	wt%		9	126.24	CA
640	OCT26D	2,6-dimethyloctane	g1	g288				$C_{10}H_{22}$	wt%		10	142.29	P
641	OCT25M	2,5-dimethyloctane	g1	g289				$C_{10}H_{22}$	wt%		10	142.29	P
642	C10P3	C10 Paraffin	g1	g290				C10H22	wt%		10	142.29	P
643	CYPNBU	n-Butylcyclopentane	g1	g291				C9H18	wt%		9	126.24	CA
644	C10P4	C10 Paraffin	g1	g292				C10H22	wt%		10	142.29	P
645	C10N1	C10 Napththene	g1	g293				C10H20	wt%		10	140.27	CA
646	C10P5	C10 Paraffin	g1	g294				C10H22	wt%		10	142.29	P
647	OCT33M	3,3-dimethyloctane	g1	g295				$C_{10}H_{22}$	wt%		10	142.29	P
648	C10N2	C10 Napththene	g1	g296				C10H20	wt%		10	140.27	CA
649	N_PRBZ	n-propylbenzene	g1	g297		p45	G	C_9H_{12}	wt%		9	120.20	A
650	OCT36M	3,6-dimethyloctane	g1	g298				$C_{10}H_{22}$	wt%		10	142.29	P
651	HP3M5E	3-methyl-5-ethylheptane	g1	g299				C10H22	wt%		10	142.29	P
652	C10N3	C10 Napththene	g1	g300				C10H20	wt%		10	140.27	CA
653	M_ETOL	1-methyl-3-ethylbenzene	g1	g301		p46	G	C_9H_{12}	wt%		9	120.20	A
654	P_ETOL	1-methyl-4-ethylbenzene	g1	g302		p47	G	C_9H_{12}	wt%		9	120.20	A
655	C10N4	C10 Napththene	g1	g303				C10H20	wt%		10	140.27	CA
656	BZ135M	1,3,5-Trimethylbenzene	g1	g304		p48	G	C_9H_{12}	wt%		9	120.20	A
657	OCT23M	2,3-dimethyloctane	g1	g305				$C_{10}H_{22}$	wt%		10	142.29	P
658	C10P6	C10 Paraffin	g1	g306				C10H22	wt%		10	142.29	P
659	C10N5	C10 Napththene	g1	g307				C10H20	wt%		10	140.27	CA
660	C10P7	C10 Paraffin	g1	g308				C10H22	wt%		10	142.29	P
661	C10P8	C10 Paraffin	g1	g309				C10H22	wt%		10	142.29	P
662	NON5M	5-methylnonane	g1	g310				C10H22	wt%		10	142.29	P
663	O_ETOL	1-methyl-2-ethylbenzene	g1	g311		p49	G	C_9H_{12}	wt%		9	120.20	A
664	NON2M	2-methylnonane	g1	g312				C10H22	wt%		10	142.29	P
665	OCT3E	3-ethyloctane	g1	g313				$C_{10}H_{22}$	wt%		10	142.29	P
666	C10N6	C10 Napththene	g1	g314				C10H20	wt%		10	140.27	CA
667	NON3M	3-methylnonane	g1	g315				C10H22	wt%		10	142.29	P
668	HP2E2M3E	3-ethyl-2-methylheptene-2	g1	g316				C10H20	wt%		10	140.27	O
669	C10N7	C10 Napththene	g1	g317				C10H20	wt%		10	140.27	CA
670	C10P9	C10 Paraffin	g1	g318				C10H22	wt%		10	142.29	P
671	C10P10	C10 Paraffin	g1	g319				C10H22	wt%		10	142.29	P
672	BZ124M	1,2,4-Trimethylbenzene	g1	g320		p50	G	C_9H_{12}	wt%		9	120.20	A
673	C10P11	C10 Paraffin	g1	g321				C10H22	wt%		10	142.29	P
674	CYHXIBU	i-Butylcyclohexane	g1	g322				C10H20	wt%		10	140.27	CA
675	C10P12	C10 Paraffin	g1	g323				C10H22	wt%		10	142.29	P
676	C10P13	C10 Paraffin	g1	g324				C10H22	wt%		10	142.29	P
677	C10P14	C10 Paraffin	g1	g325				C10H22	wt%		10	142.29	P
678	C10N8	C10 Napththene	g1	g326				C10H20	wt%		10	140.27	CA

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Para #	for CMB	Compound Name	Method [b]	Data [c]	Sum [d]	PAMS [e]	CMB [f]	Formula	Units	to ug/m3 [g]	C_no	mw	Group [h]
679	DEC1E	Decene-1	g1	g327				C10H20	wt%		10	140.27	O
680	C10P15	C10 Paraffin	g1	g328				C10H22	wt%		10	142.29	P
681	O2E23M	2,3-dimethyloctene-2	g1	g329				C10H20	wt%		10	140.27	O
682	I_BUBZ	i-butylbenzene	g1	g330				$C_{10}H_{14}$	wt%		10	134.22	A
683	CHX1TM2P	1t-Methyl-2-n-proplycyclohexane	g1	g331				C10H20	wt%		10	140.27	CA
684	C10P16	C10 Paraffin	g1	g332				C10H22	wt%		10	142.29	P
685	S_BUBZ	sec-butylbenzene	g1	g333				$C_{10}H_{14}$	wt%		10	134.22	A
686	N_DEC	n-decane	g1	g334		p51	G	$C_{10}H_{22}$	wt%		10	142.29	P
687	C11P1	C11 Paraffin	g1	g335				C11H24	wt%		11	156.31	P
688	C10N9	C10 Napththene	g1	g336				C10H20	wt%		10	140.27	CA
689	BZ123M	1,2,3-Trimethylbenzene	g1	g337		p52	G	C_9H_{12}	wt%		9	120.20	A
690	BZ1M3IPR	1-Methyl-3-i-propylbenzene	g1	g338				C10H14	wt%		10	134.22	A
691	C11N1	C11 Naphthene	g1	g339				C11H22	wt%		11	154.30	CA
692	BZ1M4IPR	1-Methyl-4-i-propylbenzene	g1	g340				C10H14	wt%		10	134.22	A
693	C11P2	C11 Paraffin	g1	g341				C11H24	wt%		11	156.31	P
694	C11P3	C11 Paraffin	g1	g342				C11H24	wt%		11	156.31	P
695	C11P4	C11 Paraffin	g1	g343				C11H24	wt%		11	156.31	P
696	INDAN	indan	g1	g344			G	C9H10	wt%		9	118.18	A
697	CYHXSBU	sec-Butylcyclohexane	g1	g345				C10H20	wt%		10	140.27	CA
698	C11P5	C11 Paraffin	g1	g346				C11H24	wt%		11	156.31	P
699	BZIM2IPR	1-Methyl-2-i-propylbenzene	g1	g347				C10H14	wt%		10	134.22	A
700	NON3E	3-ethylnonane	g1	g348				C11H24	wt%		11	156.31	P
701	C11N2	C11 Naphthene	g1	g349				C11H22	wt%		11	154.30	CA
702	C11P6	C11 Paraffin	g1	g350				C11H24	wt%		11	156.31	P
703	C11P7	C11 Paraffin	g1	g351				C11H24	wt%		11	156.31	P
704	DETBZ1	1,3-Diethylbenzene	g1	g352		p53	G	C10H14	wt%		10	134.22	A
705	BZ1M3NPR	1-Methyl-3-n-propylbenzene	g1	g353				C10H14	wt%		10	134.22	A
706	C11P8	C11 Paraffin	g1	g354				C11H24	wt%		11	156.31	P
707	DETBZ2	1,4-Diethylbenzene	g1	g355		p54	G	C10H14	wt%		10	134.22	A
708	BZ1M4NPR	1-Methyl-4-n-propylbenzene	g1	g356				C10H14	wt%		10	134.22	A
709	N_BUBZ	n-butylbenzene	g1	g357			G	$C_{10}H_{14}$	wt%		10	134.22	A
710	BZ13M5E	1,3-Dimethyl-5-ethylbenzene	g1	g358				C10H14	wt%		10	134.22	A
711	DETBZ3	1,2-Diethylbenzene	g1	g359				C10H14	wt%		10	134.22	A
712	C11P9	C11 Paraffin	g1	g360				C11H24	wt%		11	156.31	P
713	NAPTDHY	t-decahydronaphthalene	g1	g361				C11H10	wt%		11	142.20	CA
714	C11N3	C11 Naphthene	g1	g362				C11H22	wt%		11	154.30	CA
715	BZIM2NPR	1-Methyl-2-n-propylbenzene	g1	g363				C10H14	wt%		10	134.22	A
716	C11P10	C11 Paraffin	g1	g364				C11H24	wt%		11	156.31	P
717	C11P11	C11 Paraffin	g1	g365				C11H24	wt%		11	156.31	P
718	C11P12	C11 Paraffin	g1	g366				C11H24	wt%		11	156.31	P
719	C11P13	C11 Paraffin	g1	g367				C11H24	wt%		11	156.31	P
720	BZ14M2E	1,4-Dimethyl-2-ethylbenzene	g1	g368				C10H14	wt%		10	134.22	A
721	BZ13M4E	1,3-Dimethyl-4-ethylbenzene	g1	g369				C10H14	wt%		10	134.22	A
722	C11P14	C11 Paraffin	g1	g370				C11H24	wt%		11	156.31	P
723	C11P15	C11 Paraffin	g1	g371				C11H24	wt%		11	156.31	P
724	BZ12M4E	1,2-Dimethyl-4-ethylbenzene	g1	g372				C10H14	wt%		10	134.22	A
725	C11P16	C11 Paraffin	g1	g373				C11H24	wt%		11	156.31	P
726	BZ13M2E	1,3-Dimethyl-2-ethylbenzene	g1	g374				C10H14	wt%		10	134.22	A
727	C11P17	C11 Paraffin	g1	g375				C11H24	wt%		11	156.31	P
728	C11P18	C11 Paraffin	g1	g376				C11H24	wt%		11	156.31	P
729	BZ1M4TB	1-Methyl-4-t-butylbenzene	g1	g377				C11H16	wt%		11	148.25	A
730	BZ12M3E	1,2-Dimethyl-3-ethylbenzene	g1	g378				C10H14	wt%		10	134.22	A
731	BZ1E2IP	1-Ethyl-2-i-propylbenzene	g1	g379				C11H16	wt%		11	148.25	A
732	N_UNDE	n-undecane	g1	g380		p55	G	$C_{11}H_{24}$	wt%		11	156.31	P
733	BZ1E4IP	1-Ethyl-4-i-propylbenzene	g1	g381				C11H16	wt%		11	148.25	A
734	BZ1245	1,2,4,5-Tetramethylbenzene	g1	g382				$C_{10}H_{14}$	wt%		10	134.22	A
735	BZ1M2NB	1-Methyl-2-n-butylbenzene	g1	g383				C11H16	wt%		11	148.25	A
736	BZ1235	1,2,3,5-Tetramethylbenzene	g1	g384				$C_{10}H_{14}$	wt%		10	134.22	A
737	BZ1TB2M	1-t-Butyl-2-methylbenzene	g1	g385				C11H16	wt%		11	148.25	A
738	IND_5M	5-methylindan	g1	g386				C10H12	wt%		10	132.21	A
739	C12P1	C12 Paraffin	g1	g387				C12H26	wt%		12	170.34	P
740	IND_4M	4-methylindan	g1	g388				C10H12	wt%		10	132.21	A
741	BZ1E2NP	1-Ethyl-2-n-propylbenzene	g1	g389				C11H16	wt%		11	148.25	A
742	IND_2M	2-methylindan	g1	g390				C10H12	wt%		10	132.21	A
743	BZ1M3NP	1-Methyl-3-n-propylbenzene	g1	g391				C11H16	wt%		11	148.25	A
744	BZ1234	1,2,3,4-Tetramethylbenzene	g1	g392				$C_{10}H_{14}$	wt%		10	134.22	A
745	BZ13IP	1,3-Di-i-propylbenzene	g1	g393				C12H18	wt%		12	162.28	A
746	BZSPEN	s-Pentylbenzene	g1	g394				C11H16	wt%		11	148.25	A
747	BZNPEN	n-Pentylbenzene	g1	g395				C11H16	wt%		11	148.25	A
748	CYP1M2_4	1t-M-2-(4-MP)cyclopentane	g1	g396				C12H24	wt%		12	168.32	CA
749	BZ12IP	1,2-Di-i-proplybenzene	g1	g397				C12H18	wt%		12	162.28	A
750	BZIM2NB	1-Methyl-2-n-butylbenzene	g1	g398				C11H16	wt%		11	148.25	A
751	BZ14IP	1,4-Di-i-proplybenzene	g1	g399				C12H18	wt%		12	162.28	A
752	NAP1234H	1,2,3,4-tertrahydornaphthalene	g1	g400				C10H8O	wt%		10	192.17	A
753	NAPHTH	naphthalene	g1	g401			G	$C_{10}H_8$	wt%		10	128.17	A
754	BZ1TB35M	1-t-Butyl-3,5-dimethylbenzene	g1	g402				C12H18	wt%		12	162.28	A
755	C12P2	C12 Paraffin	g1	g403				C12H26	wt%		12	170.34	P
756	C12P3	C12 Paraffin	g1	g404				C12H26	wt%		12	170.34	P
757	C12P4	C12 Paraffin	g1	g405				C12H26	wt%		12	170.34	P
758	C12P5	C12 Paraffin	g1	g406				C12H26	wt%		12	170.34	P

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				Sort Codes									
Para #	**Mnemonic [a] for CMB**	**Compound Name**	**Method [b]**	**Data [c]**	**Sum [d]**	**PAMS [e]**	**CMB [f]**	**Formula**	**Units**	**Conversion to ug/m3 [g]**	**C_no**	**mw**	**Group [h]**
759	C12P6	C12 Paraffin	g1	g407				C12H26	wt%		12	170.34	P
760	BZ13NP	1,3-Di-n-propylbenzene	g1	g408				C12H18	wt%		12	162.28	A
761	C12A1	C12 Aromatic	g1	g409				C12H18	wt%		12	162.28	A
762	N_DODE	n-dodecane	g1	g410			G	$C_{12}H_{26}$	wt%		12	170.34	P
763	BZ135E	1,3,5-Triethylbenzene	g1	g411				C12H18	wt%		12	162.28	A
764	BZ1TB4E	1t-Butyl-4-ethylbenzene	g1	g412				C12H18	wt%		12	162.28	A
765	BZ124E	1,2,4-Triethylbenzene	g1	g413				C12H18	wt%		12	162.28	A
766	BZ1M4NPE	1-Methyl-4-n-pentylbenzene	g1	g414				C12H18	wt%		12	162.28	A
767	BZNHX	n-Hexylbenzene	g1	g415				C12H18	wt%		12	162.28	A
768	C13P1	C13 Parffin	g1	g416				C13H28	wt%		13	184.37	P
769	BZMPEN	Pentamethylbenzene	g1	g417				C11H16	wt%		11	148.25	A
770	NAP_2M	2-methylnaphthalene	g1	g418			G	$C_{11}H_{10}$	wt%		11	142.20	A
771	N_TRID	n-tridecane	g1	g419				$C_{13}H_{28}$	wt%		13	184.37	P
772	NAP_1M	1-methylnaphthalene	g1	g420			G	$C_{11}H_{10}$	wt%		11	142.20	A
773	IDNMHC	idnmhc, gasoline	g1	g421					wt%				
774	UNID	unidentified, gasoline	g1	g422									
775	PAMS	Sum of PAMS for gasoline	g1	g423									

Footnotes to Appendix A

a. Definition of sums of species.

PAMS	Sum of PAMS target compounds, =sum(p01..p55)
OTHER	Other identified to undecane, idnmhc-pams - sum(aa172.aa183), para#194 - para#1 - sum(para#182..para#193).
UNID	Unidentified to undecane, 0.5*UNID, 0.5 * para#195.
TNMHC	TNMHC (Para#4): total NMHC to undecane, pams + other + unid, para#1 + para#2 + para#3.
IDNMHC_p	TO14-FID identified NMHC reported by other laboratories
UNID_p	TO14-FID unidentified reported by other laboratories
IDOXY	Sum of oxygenates, sum of species with sum code = o.
CARB	Sum of carbonyls by DNPH/HPLC-UV, =sum(para#312..para#326).
HALO	Sum of halocarbons by GC-ECD, =sum(para#327..para#352)
TENAX11	Sum of tenax >undecane

b. Method Codes

c1	canister - methane, CO,CO2
c2	canister/FID - light HC, alumina column
c3	canister/FID - C3-C12, DB-1 column
c4	canister /ECD, DB-1 column
c5	canister/PDFID
d	dnph/HPLC-UV
t	tenax/GC-FID or MS
g1	direct GC-FID - gasoline
p1	TIGF filter/PUF/XAD, GC/MS for PAHs
p2	TIGF filter/PUF/XAD, GC/MS for meat and wood markers
p3	TIGF filter/PUF/XAD, GC/MS for hopanes and steranes

c. Data code: sort code corresponding to order of species in database.

d. Sum code: o - oxygenated compounds; n - non-hydrocarbon compounds; z - elutes after n-undecane.

e. PAMS target list of hydrocarbons

f. Export to data base for CMB application

g. ppbC to ug/m3 @ 1 atm, 298 K: ug/m3 = ppbC * (mw/22.4457 * C_no) and
ppbv to ug/m3 @ 1 atm, 298 K: ug/m3 = ppbv * (mw/22.4457)

h. A = aromatic, AL = Aldehyde, O = alkene (olefin), P = parafin, Y = alkyne, K = ketone, E = ether, X = haogenated, OH = alcohols, CA = cycloalkanes.

VALIDATION AND APPLICATION PROTOCOL FOR SOURCE APPORTIONMENT OF PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS) AMBIENT VOLATILE ORGANIC COMPOUUND (VOC) DATA

Appendix B

Volatile Organic Compound
Source Composition Profile Library

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
IP			CARB MEDS		**3**	CA0003	NGboiler	External combustion boiler - natural gas
IP			CARB MEDS		**4**	CA0004	PGboiler	External combustion boiler - process gas
IP			CARB MEDS		**5**	CA0005	CGboiler	External combustion boiler- coke oven gas
?			CARB MEDS		**9**	CA0009	DistOilC	Industrial ice- distillate oil
IP			CARB MEDS		**11**	CA0011	CokeOven	Coke oven stack gas - primary metals
IP			CARB MEDS		**13**	CA0013	IronSint	Iron sintering - primary metals
IP			CARB MEDS		**16**	CA0016	SteelPr1	Primary metals - steel production - basic oxygen furnace
IP			CARB MEDS		**21**	CA0021	AspRoof1	Asphalt roofing - blowing operation
IP			CARB MEDS		**22**	CA0022	AspRoof2	Asphalt roofing - dipping
IP			CARB MEDS		**24**	CA0024	AspRoof3	Asphalt roofing - tar kettle
IP			CARB MEDS		**29**	CA0029	RefBoilr	Refinery co boiler - fcc
IP			CARB MEDS		**31**	CA0031	Ref_Fug1	Refinery- fugitive emissions from covered drainage/separation pits
IP			CARB MEDS		**35**	CA0035	Ref_Fug2	Refinery cooling towers fugitive emissions
IP			CARB MEDS		**51**	CA0051	RefNGcom	Refinery flares- natural gas
IP			CARB MEDS		**53**	CA0053	Ref_Fug3	Petroleum industry - refinery catalytic reformer - fugitive emissions
IP			CARB MEDS		**72**	CA0072	Printng1	Printing ink cooking- general
AF			CARB MEDS		**76**	CA0076	Pesticid	Pesticide use- composite domestic & commercial
IP			CARB MEDS		**79**	CA0079	ChemMfg1	Flares- chemical manufacturing
SS			CARB MEDS		**90**	CA0090	Toluene	Degreasing- toluene
AV			CARB MEDS		**100**	CA0100	JETAevap	Jet fuel evaporation (jet a)
IP			CARB MEDS		**122**	CA0122	IncinSW_	Bar screen waste incinerator- solid waste
IP			CARB MEDS		**182**	CA0182	PrintSol	Evaporation- gravure printing- general solvent
COAT			CARB MEDS		**196**	CA0196	PaintSol	Architectural surface coatings- composite solvent
CP			CARB MEDS		**197**	CA0197	SolCPcom	Domestic solvents- general composite
AF			CARB MEDS		**203**	CA0203	Manure__	Animal waste decomposition
IP			CARB MEDS		**217**	CA0217	CokeOvPG	Coke oven blast furnace- process gas
SS			CARB MEDS		**230**	CA0230	PetroSt1	Petro storage- fixed roof- hexane
COAT			CARB MEDS		**280**	CA0280	PaintWBA	Surface coating primer- water based auto paint spray booth
IP			CARB MEDS		**297**	CA0297	OilEvCom	Crude oil evaporation- vapor composite from fixed roof tanks
SS			CARB MEDS		**298**	CA0298	Benzene_	Petro storage- fixed roof- benzene
SS			CARB MEDS		**299**	CA0299	Cyhexane	Petro storage- fixed roof- cyclohexane
SS			CARB MEDS		**301**	CA0301	Heptane_	Petro storage- fixed roof- heptane
SS			CARB MEDS		**303**	CA0303	Pentane_	Petro storage- fixed roof- pentane
IP			CARB MEDS		**306**	CA0306	SteelPr2	Open hearth with oxygen lance- steel production
BIO			CARB MEDS		**307**	CA0307	FrstFire	Forest fires
IP			CARB MEDS		**316**	CA0316	RefinLk1	Refinery- pipes, valves & flanges- composite
IP			CARB MEDS		**321**	CA0321	RefinLk2	Refinery- pump seals- composite
GV	97		CARB MEDS		**325**	CA0325	MTBeva97	MTBE Diurnal Evaporatives - MTBE/ETOH Fleet - 1997
GV	97		CARB MEDS		**326**	CA0326	MTB_HS97	MTBE Hot Soak Evaporatives - MTBE/ETOH Fleet - 1997
GE	97		CARB MEDS		**327**	CA0327	MTBstb97	MTBE Stabilized Exhaust - MTBE/ETOH Fleet - 1997
GE	97		CARB MEDS		**328**	CA0328	MTBstr97	MTBE Starts Exhaust - MTBE/ETOH Fleet - 1997
GV	97		CARB MEDS		**330**	CA0330	EtOeva97	EtOH Diurnal Evaporatives - MTBE/ETOH Fleet - 1997
GV	97		CARB MEDS		**331**	CA0331	EtO_HS97	EtOH Hot Soak Evaporatives - MTBE/ETOH Fleet - 1997
GE	97		CARB MEDS		**332**	CA0332	EtOstb97	EtOH Stabilized Exhaust - MTBE/ETOH Fleet - 1997
GE	97		CARB MEDS		**333**	CA0333	EtOstr97	EtOH Starts Exhaust - MTBE/ETOH Fleet - 1997
COM			CARB MEDS		**390**	CA0390	SCOSav00	SCOS97 Inventory Average Profile - 8/16/2000
COM			CARB MEDS		**391**	CA0391	SCAQav00	SCAQS97 Inventory Average Profile - 8/16/2000
GE	96		CARB MEDS		**400**	CA0400	NCAT1e96	Gasoline - non-cat - FTP Bag 1 Excess - ARB IUS summer 1996
GE	96		CARB MEDS		**401**	CA0401	NCATsb96	Gasoline - non-cat - stabilized exhaust - ARB IUS summer 1996
GE	96		CARB MEDS		**402**	CA0402	NCATsr96	Gasoline - non-cat - FTP bag1-3 STARTS - ARB IUS summer 1996
GE	96		CARB MEDS		**403**	CA0403	NCATco96	Gasoline - non-cat - FTP Composite - ARB IUS summer 1996
GE	96		CARB MEDS		**404**	CA0404	NCAT1x96	Gasoline - non-cat - FTP Bag 1 exhaust - ARB IUS summer 1996
GE	96		CARB MEDS		**405**	CA0405	NCAT3x96	Gasoline - non-cat - FTP Bag 3 exhaust - ARB IUS summer 1996
GE	94		CARB MEDS		**410**	CA0410	NCAT1e94	Gasoline - non-cat - FTP Bag 1 Excess - ARB IUS summer 1994
GE	94		CARB MEDS		**411**	CA0411	NCATsb94	Gasoline - non-cat - stabilized exhaust - ARB IUS summer 1994
GE	94		CARB MEDS		**412**	CA0412	NCATsr94	Gasoline - non-cat - FTP Bag 1-3 STARTS - ARB IUS summer 1994
GE	94		CARB MEDS		**413**	CA0413	NCATco94	Gasoline - non-cat - FTP Composite - ARB IUS summer 1994
GE	94		CARB MEDS		**414**	CA0414	NCAT1x94	Gasoline - non-cat - FTP Bag 1 exhaust - ARB IUS summer 1994
GE	94		CARB MEDS		**415**	CA0415	NCAT3x94	Gasoline - non-cat - FTP Bag 3 exhaust - ARB IUS summer 1994
GL			CARB MEDS		**419**	CA0418	LGetO11%	Liquid gasoline - ETOH 11% - 8 RVP (3.5% oxy) - MTBE/EtOH program
GL			CARB MEDS		**418**	CA0419	LGmtb11%	Liquid gasoline - MTBE 11% - Commercial grade - MTBE/EtOH program
GV	96		CARB MEDS		**420**	CA0420	CBG_HSox	CBG - hot soak - MTBE/EtOH program - LDV
GE	88		CARB MEDS		**430**	CA0430	CATstb88	Gasoline - catalyst - stabilized exhaust - ARB summer 1988
GE	89		CARB MEDS		**431**	CA0431	CATstb89	Gasoline - catalyst - stabilized exhaust - ARB summer 1989
GE	91		CARB MEDS		**432**	CA0432	CATstb91	Gasoline - catalyst - stabilized exhaust - ARB summer 1991
GE	92		CARB MEDS		**433**	CA0433	CATstb92	Gasoline - catalyst - stabilized exhaust - ARB summer 1992
GE	93		CARB MEDS		**434**	CA0434	CATstb93	Gasoline - catalyst - stabilized exhaust - ARB summer 1993
GE	95		CARB MEDS		**435**	CA0435	CATstb95	Gasoline - catalyst - stabilized exhaust - ARB summer 1995
GE	97		CARB MEDS		**436**	CA0436	CATstb97	Gasoline - catalyst - stabilized exhaust - ARB summer 1997
GE	98		CARB MEDS		**437**	CA0437	CATstb98	Gasoline - catalyst - stabilized exhaust - ARB summer 1998
GE	99		CARB MEDS		**438**	CA0438	CATstb99	Gasoline - catalyst - stabilized exhaust - ARB summer 1999
GE	1		CARB MEDS		**439**	CA0439	CATstb01	Gasoline - catalyst - stabilized exhaust - ARB summer 2001
GE	2		CARB MEDS		**440**	CA0440	CATstb02	Gasoline - catalyst - stabilized exhaust - ARB summer 2002
GE	3		CARB MEDS		**441**	CA0441	CATstb03	Gasoline - catalyst - stabilized exhaust - ARB summer 2003
GE	4		CARB MEDS		**442**	CA0442	CATstb04	Gasoline - catalyst - stabilized exhaust - ARB summer 2004
GE	6		CARB MEDS		**443**	CA0443	CATstb06	Gasoline - catalyst - stabilized exhaust - ARB summer 2006

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
GE	7		CARB MEDS		**444**	CA0444	CATstb07	Gasoline - catalyst - stabilized exhaust - ARB summer 2007
GE	8		CARB MEDS		**445**	CA0445	CATstb08	Gasoline - catalyst - stabilized exhaust - ARB summer 2008
GE	9		CARB MEDS		**446**	CA0446	CATstb09	Gasoline - catalyst - stabilized exhaust - ARB summer 2009
GV			CARB MEDS		**449**	CA0449	UnOx_eva	Gasoline - UCBerk - headspace vapors for unox SSD
GV			CARB MEDS		**450**	CA0450	2%etOeva	Gasoline - UCBerk - headspace vapors for EtOH 2.0 % O SSD
GV			CARB MEDS		**451**	CA0451	3%etOeva	Gasoline - UCBerk - headspace vapors for EtOH 3.5 % O SSD
GV			CARB MEDS		**452**	CA0452	UnO51eva	UNOX - ARB LAB- headspace vapors for fuel 51 gasoline
GV			CARB MEDS		**453**	CA0453	EtO52eva	EtOH 2.0 - ARB LAB- headspace vapors for fuel 52 gasoline
GV			CARB MEDS		**454**	CA0454	MTB50eva	MTBE 2.0 - ARB LAB- headspace vapors for fuel 50 gasoline
GE	3		CARB MEDS		**455**	CA0455	MTBstb03	MTBE 2% O catalyst - stabilized exhaust - ARB LAB 2003
GE	3		CARB MEDS		**456**	CA0456	UnOstb03	UNOX catalyst - stabilized exhaust - ARB LAB 2003
GE	3		CARB MEDS		**457**	CA0457	EtOstb03	EToH 2% O catalyst - stabilized exhaust - ARB LAB 2003
GE	3		CARB MEDS		**458**	CA0458	MTBstr03	MTBE 2% O catalyst - starts exhaust - ARB LAB 2003
GE	3		CARB MEDS		**459**	CA0459	UnOstr03	UNOX catalyst - starts exhaust - ARB LAB 2003
GE	3		CARB MEDS		**460**	CA0460	EtOstr03	EtOH 2% O catalyst - starts exhaust - ARB LAB 2003
GE	96		CARB MEDS		**470**	CA0470	CBGstb_A	CBG - catalyst stabilized - bin A (0.00-.25 g/mi THC) - 1996
GE	96		CARB MEDS	470	**471**	CA0471	CBGstb_B	CBG - catalyst stabilized - bin B (0.25-.50 g/mi THC) - 1996
GE	96		CARB MEDS	470	**472**	CA0472	CBGstb_C	CBG - catalyst stabilized - bin C (0.50-1.0 g/mi THC) - 1996
GE	96		CARB MEDS	470	**473**	CA0473	CBGstb_D	CBG - catalyst stabilized - bin D (1.00-2.0 g/mi THC) - 1996
GE	96		CARB MEDS	470	**474**	CA0474	CBGstb_E	CBG - catalyst stabilized - bin E (2.00-3.0 g/mi THC) - 1996
GE	96		CARB MEDS	470	**475**	CA0475	CBGstb_F	CBG - catalyst stabilized - bin F (>3.00 g/mi THC) - 1996
GE	95		CARB MEDS	435	**476**	CA0476	pCBstb_A	Pre-CBG - catalyst stabilized - bin A (0.00-.25 g/mi THC)
GE	95		CARB MEDS	435	**477**	CA0477	pCBstb_B	Pre-CBG - catalyst stabilized - bin B (0.25-.50 g/mi THC)
GE	95		CARB MEDS	435	**478**	CA0478	pCBstb_C	Pre-CBG - catalyst stabilized - bin C (0.50-1.0 g/mi THC)
GE	95		CARB MEDS	435	**479**	CA0479	pCBstb_D	Pre-CBG - catalyst stabilized - bin D (1.00-2.0 g/mi THC)
GE	95		CARB MEDS	435	**480**	CA0480	pCBstb_E	Pre-CBG - catalyst stabilized - bin E (2.00-3.0 g/mi THC)
GE	95		CARB MEDS	435	**481**	CA0481	pCBstb_F	Pre-CBG - catalyst stabilized - bin F (>3.00 g/mi THC)
GL	99		CARB MEDS		**485**	CA0485	LG_UnO99	UNOX LAB Compostion of fuel for test vehicles SEPT 1999
GL	99		CARB MEDS		**486**	CA0486	LG2%et99	EtOH 2.0 % o LAB Compostion of fuel for test vehicles SEPT 1999
GL	99		CARB MEDS		**487**	CA0487	LG2%MT99	MTBE 2.0 % o LAB Compostion of fuel for test vehicles SEPT 1999
GE			CARB MEDS		**500**	CA0500	CATnoC=O	Catalyst LDV exhaust - carbonyls not in ems (Black's data)
GE			CARB MEDS		**502**	CA0502	nCATnC=O	Non-catalyst LDV exhaust - carbonyls not in ems (Black's data)
IP			CARB MEDS		**504**	CA0504	BoilrOil	External combustion boilers- distillate or residual
AV			CARB MEDS		**508**	CA0508	JetExCom	Jet exhaust- composite
SS			CARB MEDS		**511**	CA0511	PolyMfg1	Plastics mfg- polypropylene
IP			CARB MEDS		**517**	CA0517	PrintEva	Printing evaporation loss- general
CP			CARB MEDS		**518**	CA0518	Aerosol1	Aerosol sprays- non-synthetic
NG			CARB MEDS		**520**	CA0520	NG_comp_	Composite natural gas
NG			CARB MEDS		**521**	CA0521	LPG_comp	Composite LPG
BIO			CARB MEDS		**523**	CA0523	PileBurn	Open burning dump- landscape/pruning (modified KVB 121)
GE	79		CARB MEDS		**526**	CA0526	VEcomp79	1979 exhaust composite 50/50 (aldehydes in emissions)
GE			CARB MEDS		**527**	CA0527	nCATwC=O	Non-cat LDV exhaust (carbonyls in emissions) Black's data
IP			CARB MEDS		**528**	CA0528	OCS_Fug1	OCS production platform fugitives
IP			CARB MEDS		**529**	CA0529	PetDril1	Oil & gas extraction - pipeline valves & fittings
IP			CARB MEDS	529	**530**	CA0530	PetDril2	Oil & gas extraction - pump seals
IP			CARB MEDS	529	**531**	CA0531	PetDril3	Oil & gas extraction - compressor seals
IP			CARB MEDS	529	**532**	CA0532	PetDril4	Oil & gas extraction - well heads & cellars/oil&water separator
AF			CARB MEDS		**533**	CA0533	CAagriAM	Daytime biogenic profile- Kern county crops
AF			CARB MEDS		**534**	CA0534	CAagriPM	Nighttime biogenic profile - Kern county crops
IP			CARB MEDS		**535**	CA0535	CoalComb	Coal combustion - bituminous - fluidized bed
IP			CARB MEDS		**546**	CA0546	OilStor1	Crude oil - storage tanks - Kern county
SS			CARB MEDS		**547**	CA0547	Propane_	Propane
SS			CARB MEDS		**548**	CA0548	Butane__	Butane
RC			CARB MEDS		**549**	CA0549	WdStvHW1	Red oak combustion - wood stove (w/o catalyst)
IP			CARB MEDS		**550**	CA0550	OCS_Fug2	OCS - gas seeps
IP			CARB MEDS		**551**	CA0551	OCS_Fug3	OCS - oil seeps - volatile fraction
SS			CARB MEDS		**559**	CA0559	Ethane__	Ethane
DE	88		CARB MEDS	561	**560**	CA0560	DEnC=O88	On-road diesel hot exhaust (carbonyls not in emissions) EPA 4/88
DE	88		CARB MEDS		**561**	CA0561	DEonRd88	On-road diesel hot exhaust EPA 4/88
IP			CARB MEDS		**562**	CA0562	EPwrGen1	Geysers power plant main steam
AV			CARB MEDS		**563**	CA0563	Jet4evap	Jet fuel evaporation (jp-4)
GE			CARB MEDS		**564**	CA0564	CATcsRF1	Gasoline - catalyst - cold start exhaust - a/o RFA phase 1
GE			CARB MEDS		**565**	CA0565	CATsbRF1	Gasoline - catalyst - stabilized exhaust - a/o RFA phase 1
GE			CARB MEDS		**566**	CA0566	CATwsRF1	Gasoline - catalyst - hot start exhaust - a/o RFA phase 1
GE			CARB MEDS		**570**	CA0570	CATcsCBG	CBG M7&8 - catalyst - cold start exhaust - a/o phase 2
GE			CARB MEDS		**571**	CA0571	CATsbCBG	CBG M7&8 - catalyst - stabilized exhaust - a/o phase 2
GE			CARB MEDS		**572**	CA0572	CATwsCBG	CBG M7&8 - catalyst - hot start exhaust - a/o phase 2
GE			CARB MEDS		**573**	CA0573	CATcmCBG	CBG M7&8 - catalyst - composite exhaust - a/o phase 2
GE			CARB MEDS		**574**	CA0574	CATcsRF2	RFA M7&8 - catalyst - cold start exhaust - a/o phase 2
GE			CARB MEDS		**575**	CA0575	CATsbRF2	RFA M7&8 - catalyst - stabilized exhaust - a/o phase 2
GE			CARB MEDS		**576**	CA0576	CATwsRF2	RFA M7&8 - catalyst - hot start exhaust - a/o phase 2
GE			CARB MEDS		**577**	CA0577	CATcmRF2	RFA M7&8 - catalyst - composite exhaust - a/o phase 2
AV			CARB MEDS		**586**	CA0586	Jet5exh_	Composite jet exhaust JP-5 (EPA 1097-1099)
COM			CARB MEDS		**600**	CA0600	AllComp	Species unknown- all category composite
GE	10		CARB MEDS		**601**	CA0601	CATsr_10	Compsite 2010 - cat - start exhaust - 40%unox 60%etoh 2%o
GE	10		CARB MEDS		**602**	CA0602	CATsb_10	Compsite 2010 - cat - stabilized exhaust - 40%unox 60%etoh 2%o
GE	10		CARB MEDS		**603**	CA0603	nCATsr10	Compsite 2010 -ncat - start exhaust - 40%unox 60%etoh 2%o
GE	10		CARB MEDS		**604**	CA0604	nCATsb10	Compsite 2010 -ncat - stabilized exhaust - 40%unox 60%etoh 2%o
GV	10		CARB MEDS		**605**	CA0605	GasEva10	Composite Diurnal Vaporse - 2010 40% unox 60% etoh 2% o

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
GL	10		CARB MEDS		**606**	CA0606	LGcomp10	Composite Liquid Gasoline - 2010 40% unox 60% etoh 2% o
GE	0		CARB MEDS		**610**	CA0610	LDGVcs00	CBG - LDGV cat - cold start exhaust - auto/oil phase 2:2000
GE	0		CARB MEDS		**611**	CA0611	LDGTcs00	CBG - LDGT cat - cold start exhaust - auto/oil phase 2:2000
GE	0		CARB MEDS		**612**	CA0612	LDGVsb00	CBG - LDGV cat - hot stabilized - auto/oil phase 2:2000
GE	0		CARB MEDS		**613**	CA0613	LDGTsb00	CBG - LDGT cat - hot stabilized - auto/oil phase 2:2000
GE	0		CARB MEDS		**614**	CA0614	LDGVws00	CBG - LDGV cat - hot start exhaust - auto/oil phase 2:2000
GE	0		CARB MEDS		**615**	CA0615	LDGTws00	CBG - LDGT cat - hot start exhaust - auto/oil phase 2:2000
GE	0		CARB MEDS		**616**	CA0616	LDGeva00	CBG - diurnal- Phase 2:2000 auto/oil LDGV & LDGT
GV	0		CARB MEDS		**617**	CA0617	LDGVhs00	CBG - hot soak Phase 2:2000 auto/oil LDGV - conforming
GV	0		CARB MEDS		**618**	CA0618	LDGThs00	CBG - hot soak Phase 2:2000 auto/oil LDGT - conforming
GV	0		CARB MEDS		**619**	CA0619	LDGrnl00	CBG - running loss - Phase 2:2000 auto/oil LDGV&LDGT
GV	0		CARB MEDS		**620**	CA0620	LDGrsl00	CBG - resting loss - Phase 2:2000 auto/oil LDGV&LDGT
GE	10		CARB MEDS		**621**	CA0621	LDGVcs10	CBG - LDGV cat - cold start exhaust - auto/oil phase 2:2010
GE	10		CARB MEDS		**622**	CA0622	LDGTcs10	CBG - LDGT cat - cold start exhaust - auto/oil phase 2:2010
GE	10		CARB MEDS		**623**	CA0623	LDGVsb10	CBG - LDGV cat - hot stabilized - auto/oil phase 2:2010
GE	10		CARB MEDS		**624**	CA0624	LDGTsb10	CBG - LDGT cat - hot stabilized - auto/oil phase 2:2010
GE	10		CARB MEDS		**625**	CA0625	LDGVws10	CBG - LDGV cat - hot start exhaust - auto/oil phase 2:2010
GE	10		CARB MEDS		**626**	CA0626	LDGTws10	CBG - LDGT cat - hot start exhaust - auto/oil phase 2:2010
GE	10		CARB MEDS		**627**	CA0627	LDGeva10	CBG - diurnal- Phase 2:2010 auto/oil LDGV & LDGT
GV	10		CARB MEDS		**628**	CA0628	LDGVhs10	CBG - hot soak Phase 2:2010 auto/oil LDGV - conforming
GV	10		CARB MEDS		**629**	CA0629	LDGThs10	CBG - hot soak Phase 2:2010 auto/oil LDGT - conforming
GV	10		CARB MEDS		**630**	CA0630	LDGrnl10	CBG - running loss - Phase 2:2010 auto/oil LDGV&LDGT
GV	10		CARB MEDS		**631**	CA0631	LDGrsl10	CBG - resting loss - Phase 2:2010 auto/oil LDGV&LDGT
GE	3		CARB MEDS		**636**	CA0636	UnO_sb03	Cat stabilzed exhaust 2003 SSD unox V5 (MTBE phaseout)
GE	3		CARB MEDS		**637**	CA0637	EtO_sb03	Cat stabilzed exhaust 2003 SSD et20 V5 (MTBE phaseout)
GE	96		CARB MEDS		**640**	CA0640	NCsbUn96	Non-cat stabilzed exhaust 1996 SSD unox V5 (MTBE phaseout)
GE	96		CARB MEDS		**641**	CA0641	NCsrUn96	Non-cat start exhaust 1996 SSD unox V5 (MTBE phaseout)
GE	96		CARB MEDS		**642**	CA0642	CTsbUn96	Cat stabilized exhaust 1996 SSD unox V5 (MTBE phaseout)
GE	96		CARB MEDS		**643**	CA0643	CTsrUn96	Cat start exhaust 1996 SSD unox V5 (MTBE phaseout)
GE	96		CARB MEDS		**646**	CA0646	NCsbEt96	Non-cat stabilzed exhaust 1996 SSD etoh 2.0% o V5 (MTBE phaseout)
GE	96		CARB MEDS		**647**	CA0647	NCsrEt96	Non-cat start exhaust 1996 SSD etoh 2.0% o V5 (MTBE phaseout)
GE	96		CARB MEDS		**648**	CA0648	CTsbEt96	Cat stabilized exhaust 1996 SSD 2.0% o V5 (MTBE phaseout)
GE	96		CARB MEDS		**649**	CA0649	CTsrEt96	Cat start exhaust 1996 SSD 2.0% o V5 (MTBE phaseout)
GL	96		CARB MEDS		**650**	CA0650	LG_UnO96	Liquid gasoline 1996 SSD unox (MTBE phaseout)
GV	96		CARB MEDS	661	**651**	CA0651	EvaUnO96	Headspace vapors 1996 SSD unox (MTBE phaseout)
GV	96		CARB MEDS	662	**652**	CA0652	HS_UnO96	Hot soak vapors 1996 SSD unox (MTBE phaseout)
GE	96		CARB MEDS		**653**	CA0653	CsbUnO96	Cat stabilzed exhaust 1996 SSD unox (MTBE phaseout)
GE	96		CARB MEDS		**654**	CA0654	CsrUnO96	Cat start exhaust 1996 SSD unox (MTBE phaseout)
GE	96		CARB MEDS		**655**	CA0655	nCsbUn96	Non-cat stabilized exhaust 1996 SSD unox (MTBE phaseout)
GE	96		CARB MEDS		**656**	CA0656	nCsrUn96	Non-cat start exhaust 1996 SSD unox (MTBE phaseout)
GE	3		CARB MEDS		**657**	CA0657	CsbUnO03	Cat stabilzed exhaust 2003 SSD unox (MTBE phaseout)
GL	96		CARB MEDS		**660**	CA0660	LG_EtO96	Liquid gasoline 1996 SSD etoh 2.0% o (MTBE phaseout)
GV	96		CARB MEDS		**661**	CA0661	EvaEtO96	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)
GV	96		CARB MEDS		**662**	CA0662	HS_EtO96	Hot soak vapors 1996 SSD etoh 2.0% o (MTBE phaseout)
GE	96		CARB MEDS		**663**	CA0663	CsbEtO96	Cat stabilzed exhaust 1996 SSD etoh 2.0% o (MTBE phaseout)
GE	96		CARB MEDS		**664**	CA0664	CsrEtO96	Cat start exhaust 1996 SSD etoh 2.0% o (MTBE phaseout)
GE	96		CARB MEDS		**665**	CA0665	nCsbEt96	Non-cat stabilized exhaust 1996 SSD 2.0% o (MTBE phaseout)
GE	96		CARB MEDS		**666**	CA0666	nCsrEt96	Non-cat start exhaust 1996 SSD 2.0% o (MTBE phaseout)
GE	3		CARB MEDS		**667**	CA0667	CsbEtO03	Cat stabilzed exhaust 2003 SSD 2.0% o (MTBE phaseout)
GL	96		CARB MEDS	660	**670**	CA0670	LG_3%O96	Liquid gasoline 1996 SSD 3.5% o (MTBE phaseout)
GV	96		CARB MEDS	661	**671**	CA0671	Eva3%O96	Headspace vapors 1996 SSD 3.5% 0 (MTBE phaseout)
GV	96		CARB MEDS	662	**672**	CA0672	HS_3%O96	Hot soak vapors 1996 SSD 3.5% o (MTBE phaseout)
GE	96		CARB MEDS		**673**	CA0673	Csb3%O96	Cat stabilzed exhaust 1996 SSD 3.5% o (MTBE phaseout)
GE	96		CARB MEDS		**674**	CA0674	Csr3%O96	Cat start exhaust 1996 SSD 3.5% o (MTBE phaseout)
GE	96		CARB MEDS		**675**	CA0675	nCsb3%96	Non-cat stabilized exhaust 1996 SSD 3.5% o (MTBE phaseout)
GE	96		CARB MEDS		**676**	CA0676	nCsr3%96	Non-cat start exhaust 1996 SSD 3.5% o (MTBE phaseout)
GE	3		CARB MEDS		**677**	CA0677	Csb3%O03	Cat stabilzed exhaust 2003 SSD 3.5% o (MTBE phaseout)
GL	85		CARB MEDS		**707**	CA0707	LGcom_85	Liquid gasoline 1985 (profile 709 normalized to 100%)
GV	85		CARB MEDS		**708**	CA0708	GVcom_85	Gasoline vapors-1985 (profile 710 normalized to 100%)
GL	85		CARB MEDS		**709**	CA0709	LGcomS85	Liquid gasoline-composite of product-summer blend (1985)
GV	85		CARB MEDS		**710**	CA0710	GVcomS85	Gasoline vapors-composite of product-summer blend (1985)
IP			CARB MEDS		**711**	CA0711	PntILaqr	Industrial surface coating-composite laquer
IP			CARB MEDS		**712**	CA0712	PntIEnam	Industrial surface coating-composite enamel
IP			CARB MEDS		**713**	CA0713	PntIPrim	Industrial surface coating-composite primer
IP			CARB MEDS		**714**	CA0714	PntIAdhe	Industrial surface coating-composite adhesive
IP			CARB MEDS		**715**	CA0715	Asphalt1	Slow cure asphalt
IP			CARB MEDS		**716**	CA0716	Asphalt2	Medium cure asphalt
NG			CARB MEDS		**719**	CA0719	NG_ICE__	ICE-reciprocating-natural gas
GL			CARB MEDS		**729**	CA0729	LGcomW??	Liquid gasoline-composite of product-winter blend
GV			CARB MEDS		**730**	CA0730	GVcomW??	Gasoline vapors-composite of product-winter blend
SS			CARB MEDS		**753**	CA0753	Styrene	Styrene
IP			CARB MEDS		**756**	CA0756	PetrFug1	Oil & gas production fugitives-liquid service
IP			CARB MEDS		**757**	CA0757	PetrFug2	Oil & gas production fugitives-gas service
IP			CARB MEDS	756	**758**	CA0758	PetrFug3	Oil & gas production fugitives-valves-unspecified
IP			CARB MEDS		**760**	CA0760	DFuelEva	Evaporative emissions-distillate fuel
IP			CARB MEDS		**763**	CA0763	ChemMfg2	Phthalic anhydride mfg.-xylene oxidation
SS			CARB MEDS		**772**	CA0772	O_XYLene	Ortho-xylene
COAT			CARB MEDS		**783**	CA0783	PntISolB	Industrial surface coating-solvent based paint

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
IP			CARB MEDS		**784**	CA0784	ChemMfg3	Synthetic rubber mfg-styrene-butadiene rubber
IP			CARB MEDS		**787**	CA0787	CarbnMfg	Carbon black manufacturing
SS			CARB MEDS		**791**	CA0791	Varsol__	Varsol
SS			CARB MEDS		**793**	CA0793	CyPentan	Cyclopentane
SS			CARB MEDS		**794**	CA0794	IsOctane	Isooctane
GE	82		CARB MEDS		**800**	CA0800	CAT_nC=O	Catalyst ldv exhaust - no carbonyls in emissions - Sigby's data
GE	82		CARB MEDS		**801**	CA0801	CAT_wC=O	Catalyst ldv exhaust - carbonyls in emissions - Sigby's data
IP			CARB MEDS		**802**	CA0802	MnSpirit	Composite mineral spirit (naphthas or lactol spirits)
SS			CARB MEDS	2068	**806**	CA0806	Isoprene	Isoprene & soil NO
CP	95		CARB MEDS	1799	**814**	CA0814	CPcomp95	EPA composite consumer products 9/29/95
GE	91		CARB MEDS		**815**	CA0815	SmE2cy91	Utility equipment - gasoline - 2 cycle - CalPoly 1991
GE	91		CARB MEDS		**816**	CA0816	SmE4cy91	Utility equipment - gasoline - 4 cycle - CalPoly 1991
DE			CARB MEDS	818	**817**	CA0817	AgDiesel	Farm equipment - diesel - light & heavy - (ems=HC)
DE			CARB MEDS		**818**	CA0818	AgDiesel	Farm equipment - diesel - light & heavy - (ems=actual weight)
CP			CARB MEDS		**821**	CA0821	CPcom+Ac	EPA composite consumer products with increased acetone & perc
GE	94		CARB MEDS		**827**	CA0827	CAT1xS94	Gasoline - catalyst - FTP Bag 1 Excess - ARB IUS summer 1994
GE	94		CARB MEDS		**828**	CA0828	CATsbS94	Gasoline - catalyst - stabilized exhaust - ARB IUS summer 1994
GE	94		CARB MEDS		**829**	CA0829	CATsrS94	Gasoline - catalyst - FTP Bag 1-3 STARTS - ARB IUS summer 1994
GE	94		CARB MEDS		**830**	CA0830	CATcmS94	Gasoline - catalyst - FTP Composite - ARB IUS summer 1994
GE	94		CARB MEDS		**831**	CA0831	CATb1S94	Gasoline - catalyst - FTP Bag 1 exhaust - ARB IUS summer 1994
GE	94		CARB MEDS		**832**	CA0832	CATb3S94	Gasoline - catalyst - FTP Bag 3 exhaust - ARB IUS summer 1994
GE			CARB MEDS		**833**	CA0833	CATcsCNG	Gasoline - catalyst - cold start exhaust - CNG - annual
GE			CARB MEDS		**835**	CA0835	CATwsCNG	Gasoline - catalyst - hot start exhaust - CNG - annual
GE			CARB MEDS		**836**	CA0836	CATcsLPG	Gasoline - catalyst - cold start exhaust - LPG - annual
GE			CARB MEDS		**837**	CA0837	CATsbLPG	Gasoline - catalyst - stabilized exhaust - LPG - annual
GE			CARB MEDS		**838**	CA0838	CATwsLPG	Gasoline - catalyst - hot start exhaust - LPG - annual
GE			CARB MEDS		**839**	CA0839	CATcsM85	Gasoline - catalyst - cold start exhaust - M85 - annual
GE			CARB MEDS		**840**	CA0840	CATsbM85	Gasoline - catalyst - stabilized exhaust - M85 - annual
GE			CARB MEDS		**841**	CA0841	CATwsM85	Gasoline - catalyst - hot start exhaust - M85 - annual
GE	95		CARB MEDS		**842**	CA0842	CATcsS95	Gasoline - catalyst - cold start exhaust - ARB IUS summer 1995
GE	95		CARB MEDS		**843**	CA0843	CATsbS95	Gasoline - catalyst - stabilized exhaust - ARB IUS summer 1995
GE	95		CARB MEDS		**844**	CA0844	CATwsS95	Gasoline - catalyst - hot start exhaust - ARB IUS summer 1995
GE	95		CARB MEDS		**845**	CA0845	CATcmS95	Gasoline - catalyst - composite exhaust - ARB IUS summer 1995
GL			CARB MEDS		**850**	CA0850	LGphs2S_	Liquid gasoline-theoretical Phase 2 -summer blend
GV			CARB MEDS		**851**	CA0851	GVphs2S_	Gasoline vapors-theoretical Phase 2 -summer blend
GE	87		CARB MEDS		**860**	CA0860	CAT1xS87	Gasoline - catalyst - FTP Bag 1 Excess - ARB IUS summer 1987
GE	87		CARB MEDS		**861**	CA0861	CATsbS87	Gasoline - catalyst - stabilized exhaust - ARB IUS summer 1987
GE	87		CARB MEDS		**862**	CA0862	CATsrS87	Gasoline - catalyst - FTP Bag 1-3 STARTS - ARB IUS summer 1987
GE	87		CARB MEDS		**863**	CA0863	CATcmS87	Gasoline - catalyst - FTP Composite - ARB IUS summer 1987
GE	87		CARB MEDS		**864**	CA0864	CATb1S87	Gasoline - catalyst - FTP Bag 1 exhaust - ARB IUS summer 1987
GE	87		CARB MEDS		**865**	CA0865	CATb3S87	Gasoline - catalyst - FTP Bag 3 exhaust - ARB IUS summer 1987
GE	90		CARB MEDS		**866**	CA0866	CAT1xS90	Gasoline - catalyst - FTP Bag 1 Excess - ARB IUS summer 1990
GE	90		CARB MEDS		**867**	CA0867	CATsbS90	Gasoline - catalyst - stabilized exhaust - ARB IUS summer 1990
GE	90		CARB MEDS		**868**	CA0868	CATsrS90	Gasoline - catalyst - FTP Bag 1-3 STARTS - ARB IUS summer 1990
GE	90		CARB MEDS		**869**	CA0869	CATcmS90	Gasoline - catalyst - FTP Composite - ARB IUS summer 1990
GE	90		CARB MEDS		**870**	CA0870	CATb1S90	Gasoline - catalyst - FTP Bag 1 exhaust - ARB IUS summer 1990
GE	90		CARB MEDS		**871**	CA0871	CATb3S90	Gasoline - catalyst - FTP Bag 3 exhaust - ARB IUS summer 1990
GE	96		CARB MEDS		**875**	CA0875	CAT1xS96	Gasoline - catalyst - FTP Bag 1 Excess - ARB IUS summer 1996
GE	96		CARB MEDS		**876**	CA0876	CATsbS96	Gasoline - catalyst - stabilized exhaust - ARB IUS summer 1996
GE	96		CARB MEDS		**877**	CA0877	CATsrS96	Gasoline - catalyst - FTP Bag 1-3 STARTS - ARB IUS summer 1996
GE	96		CARB MEDS		**878**	CA0878	CATcmS96	Gasoline - catalyst - FTP Composite - ARB IUS summer 1996
GE	96		CARB MEDS		**879**	CA0879	CATb1S96	Gasoline - catalyst - FTP Bag 1 exhaust - ARB IUS summer 1996
GE	96		CARB MEDS		**880**	CA0880	CATb3S96	Gasoline - catalyst - FTP Bag 3 exhaust - ARB IUS summer 1996
GE	0		CARB MEDS		**881**	CA0881	CAT1xS00	Gasoline - catalyst - FTP Bag 1 Excess- from 96IUS summer 2000
GE	0		CARB MEDS		**882**	CA0882	CATsbS00	Gasoline - catalyst -stabilized exhaust-from 96IUS summer 2000
GE	0		CARB MEDS		**883**	CA0883	CATsrS00	Gasoline - catalyst - FTP Bag 1-3 STARTS - 96IUS summer 2000
GE	0		CARB MEDS		**884**	CA0884	CATcmS00	Gasoline - catalyst - FTP Composite- from 96IUS summer 2000
GE	0		CARB MEDS		**885**	CA0885	CATb1S00	Gasoline - catalyst - FTP Bag 1 exhaust-from 96IUS summer 2000
GE	0		CARB MEDS		**886**	CA0886	CATb3S00	Gasoline - catalyst - FTP Bag 3 exhaust-from 96IUS summer 2000
GE	5		CARB MEDS		**887**	CA0887	CAT1xS05	Gasoline - catalyst - FTP Bag 1 Excess- from 96IUS summer 2005
GE	5		CARB MEDS		**888**	CA0888	CATsbS05	Gasoline - catalyst -stabilized exhaust-from 96IUS summer 2005
GE	5		CARB MEDS		**889**	CA0889	CATsrS05	Gasoline - catalyst - FTP Bag 1-3 STARTS - 96IUS summer 2005
GE	5		CARB MEDS		**890**	CA0890	CATcmS05	Gasoline - catalyst - FTP Composite- from 96IUS summer 2005
GE	5		CARB MEDS		**891**	CA0891	CATb1S05	Gasoline - catalyst - FTP Bag 1 exhaust-from 96IUS summer 2005
GE	5		CARB MEDS		**892**	CA0892	CATb3S05	Gasoline - catalyst - FTP Bag 3 exhaust-from 96IUS summer 2005
GE	10		CARB MEDS		**893**	CA0893	CAT1xS10	Gasoline - catalyst - FTP Bag 1 Excess- from 96IUS summer 2010
GE	10		CARB MEDS		**894**	CA0894	CATsbS10	Gasoline - catalyst -stabilized exhaust-from 96IUS summer 2010
GE	10		CARB MEDS		**895**	CA0895	CATsrS10	Gasoline - catalyst - FTP Bag 1-3 STARTS - 96IUS summer 2010
GE	10		CARB MEDS		**896**	CA0896	CATcmS10	Gasoline - catalyst - FTP Composite- from 96IUS summer 2010
GE	10		CARB MEDS		**897**	CA0897	CATb1S10	Gasoline - catalyst - FTP Bag 1 exhaust-from 96IUS summer 2010
GE	10		CARB MEDS		**898**	CA0898	CATb3S10	Gasoline - catalyst - FTP Bag 3 exhaust-from 96IUS summer 2010
GE	96		CARB MEDS		**899**	CA0899	CATs1S96	Gasoline - catalyst - FTP Bag 1 -STARTS - ARB IUS summer 1996
VE	94		CARB MEDS		**901**	CA0901	CalTuS94	Caldecott tunnel emissions - summer 1994 - mostly hot stabilized
VE	95		CARB MEDS		**903**	CA0903	CalTuS95	Caldecott tunnel emissions - summer 1995 - mostly hot stabilized
VE	96		CARB MEDS		**905**	CA0905	CalTuS96	Caldecott tunnel emissions - summer 1996 - mostly hot stabilized
GV			CARB MEDS		**906**	CA0906	GV2%MTBE	Gasoline - UCBerk - headspace vapors for MTBE 2.0 % O gasoline
IP			CARB MEDS		**919**	CA0919	Degreas1	DEGREASING: COLD CLEANING (BATCH, CONVEYOR, SPRAY GUN)
IP			CARB MEDS	919	**920**	CA0920	Degreas2	DEGREASING: HANDWIPING

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
IP			CARB MEDS	90	**921**	CA0921	Degreas3	DEGREASING: COLD CLEANING (BATCH, CONVEYOR, SPRAY GUN)
IP			CARB MEDS	90	**922**	CA0922	Degreas4	DEGREASING: HANDWIPING
IP			CARB MEDS		**930**	CA0930	Degreas5	DEGREASING: COLD CLEANING (BATCH, CONVEYOR, SPRAY GUN)
IP			CARB MEDS		**932**	CA0932	Degreas6	DEGREASING: HANDWIPING
SS			CARB MEDS		**940**	CA0940	IPentane	Isopentane
IP			CARB MEDS		**1402**	CA1402	H2OTreat	POTWs Wastewater Treatment, AB2588 Data, USEPA 50% unidentif.
IP			CARB MEDS		**1403**	CA1403	InduComp	INDUSTRIAL PROCESSES - AVERAGE (EPA 9003)
IP			CARB MEDS		**1404**	CA1404	ChemMfgC	CHEMICAL MANUFACTURING - AVERAGE (EPA 9004)
IP			CARB MEDS		**1405**	CA1405	PlastMfg	PLASTICS PRODUCTION - AVERAGE (EPA 9005)
IP			CARB MEDS		**1409**	CA1409	MetalMf1	PRIMARY METAL PRODUCTION - AVERAGE (EPA 9009)
IP			CARB MEDS		**1410**	CA1410	MetalMf2	SECONDARY METAL PRODUCTION - AVERAGE (EPA 9010)
IP			CARB MEDS		**1411**	CA1411	MinerMfg	MINERAL PRODUCTS - AVERAGE (EPA 9011)
IP			CARB MEDS		**1412**	CA1412	PetPrCom	PETROLEUM INDUSTRY - AVERAGE (EPA 9012)
IP			CARB MEDS		**1414**	CA1414	RubbrMfg	RUBBER/MISC. PLASTICS PRODUCTN - AVERAGE (EPA 9014)
IP			CARB MEDS		**1417**	CA1417	DryClean	DRYCLEANING/DEGREASING - AVERAGE (EPA 9017)
COAT			CARB MEDS		**1421**	CA1421	Painting	SURFACE COATING OPERATIONS - AVERAGE (EPA 9021)
IP			CARB MEDS		**1426**	CA1426	Printing	PRINTING/PUBLISHING - AVERAGE (EPA 9026)
IP			CARB MEDS		**1428**	CA1428	ChemStor	ORGANIC CHEMICAL STORAGE - AVERAGE (EPA 9028)
IP			CARB MEDS		**1430**	CA1430	ChemSto2	ORGANIC CHEM/FIXED ROOF:MISC ALKANES - AVG (EPA 9030)
IP			CARB MEDS		**1448**	CA1448	AutoPntg	AUTO REFINISHING (US EPA #2402)
IP			CARB MEDS		**1449**	CA1449	MetalFab	FABRICATED METAL (US EPA #2466)
CP			CARB MEDS		**1502**	CA1502	CP_adhs1	DRAFT CONSUMER PRD: ARTS AND CRAFTS ADHESIVES
CP			CARB MEDS		**1503**	CA1503	CP_adhs2	DRAFT CONSUMER PRD: AUTOMOTIVE ADHESIVES
CP			CARB MEDS		**1504**	CA1504	CP_adhs3	DRAFT CONSUMER PRD: CARPET AND TILE ADHESIVES
CP			CARB MEDS		**1505**	CA1505	CP_adhs4	DRAFT CONSUMER PRD: CONSTRUCTION AND PANEL ADHESIVES
CP			CARB MEDS		**1506**	CA1506	CP_adhs5	DRAFT CONSUMER PRD: CONTACT ADHESIVE
CP			CARB MEDS		**1507**	CA1507	CP_adhs6	DRAFT CONSUMER PRD: GENERAL PURPOSE ADHESIVE
CP			CARB MEDS		**1508**	CA1508	CP_adhs7	DRAFT CONSUMER PRD: AEROSOL ADHESIVE (INCLUDING INDUSTRIAL)
CP			CARB MEDS		**1520**	CA1520	CP_caulk	DRAFT CONSUMER PRD: SEALANTS & CAULKING COMPOUNDS
CP			CARB MEDS		**1521**	CA1521	CP_wdfil	DRAFT CONSUMER PRD: WOOD FILLERS
CP			CARB MEDS		**1530**	CA1530	CPauto_1	DRAFT CONSUMER PRD: BUG AND TAR REMOVERS
CP			CARB MEDS		**1531**	CA1531	CPauto_2	DRAFT CONSUMER PRD: AUTO CARPET AND UPHOLSTERY CLEANERS - AEROSOLS
CP			CARB MEDS		**1533**	CA1533	CPauto_3	DRAFT CONSUMER PRD: AUTOMOTIVE HARD PASTE WAXES
CP			CARB MEDS		**1535**	CA1535	CPauto_4	DRAFT CONSUMER PRD: AUTOMOTIVE WAXES/POLISHES/SEALANTS/GLAZES
CP			CARB MEDS		**1536**	CA1536	CPauto_5	DRAFT CONSUMER PRD: RUBBER AND VINYL PROTECTANTS - AEROSOLS
CP			CARB MEDS		**1537**	CA1537	CPauto_6	DRAFT CONSUMER PRD: RUBBER AND VINYL PROTECTANTS - NON-AEROSOLS
CP			CARB MEDS		**1538**	CA1538	CPauto_7	DRAFT CONSUMER PRD: AUTOMOTIVE RUBBING OR POLISHING COMPOUNDS
CP			CARB MEDS		**1539**	CA1539	CPauto_8	DRAFT CONSUMER PRD: TIRE CLEANERS
CP			CARB MEDS		**1540**	CA1540	CPauto_9	DRAFT CONSUMER PRD: VINYL AND LEATHER CLEANERS
CP			CARB MEDS		**1541**	CA1541	CPauto10	DRAFT CONSUMER PRD: WHEEL CLEANERS
CP			CARB MEDS		**1550**	CA1550	CPauto11	DRAFT CONSUMER PRD: BATTERY CLEANERS
CP			CARB MEDS		**1551**	CA1551	CPauto12	DRAFT CONSUMER PRD: AUTOMOTIVE BRAKE CLEANERS
CP			CARB MEDS		**1552**	CA1552	CPauto13	DRAFT CONSUMER PRD: CARBURETOR OR FUEL-INJECTION AIR INTAKE CLEANERS
CP			CARB MEDS		**1553**	CA1553	CPauto14	DRAFT CONSUMER PRD: ENGINE DEGREASERS - AEROSOLS
CP			CARB MEDS		**1554**	CA1554	CPauto15	DRAFT CONSUMER PRD: ENGINE DEGREASERS - NON-AEROSOLS
CP			CARB MEDS		**1555**	CA1555	CPauto16	DRAFT CONSUMER PRD: SOLVENT PARTS CLEANER - AEROSOLS
CP			CARB MEDS		**1556**	CA1556	CPauto17	DRAFT CONSUMER PRD: SOLVENT PARTS CLEANER - NON-AEROSOLS
CP			CARB MEDS		**1558**	CA1558	CPauto18	DRAFT CONSUMER PRD: AUTOMOTIVE UNDERCOATINGS - AEROSOLS
CP			CARB MEDS		**1559**	CA1559	CPauto19	DRAFT CONSUMER PRD: AUTOMOTIVE UNDERCOATINGS - NON-AEROSOLS
CP			CARB MEDS		**1570**	CA1570	CPsolv_1	DRAFT CONSUMER PRD: GRAFFITI REMOVERS
CP			CARB MEDS		**1571**	CA1571	CPsolv_2	DRAFT CONSUMER PRD: PAINT REMOVERS OR STRIPPERS
CP			CARB MEDS		**1580**	CA1580	CPsolv_3	DRAFT CONSUMER PRD: MULTIPURPOSE SOLVENTS
CP			CARB MEDS		**1581**	CA1581	CPsolv_4	DRAFT CONSUMER PRD: ELECTRONIC CLEANER
CP			CARB MEDS		**1582**	CA1582	CPsolv_5	DRAFT CONSUMER PRD: ADHESIVE REMOVER

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
CP			CARB MEDS		**1600**	CA1600	CPpesti1	DRAFT CONSUMER PRD: NON-SELECTIVE HERBICIDES/DEFOLIANTS
CP			CARB MEDS		**1601**	CA1601	CPpesti2	DRAFT CONSUMER PRD: SELECTIVE HERBICIDES/DEFOLIANTS
CP			CARB MEDS		**1613**	CA1613	CPpesti3	DRAFT CONSUMER PRD: WASP AND HORNET INSECTICIDE
CP			CARB MEDS		**1614**	CA1614	CPpesti4	DRAFT CONSUMER PRD: LAWN AND GARDEN INSECTICIDES
CP			CARB MEDS		**1615**	CA1615	CPpesti5	DRAFT CONSUMER PRD: CRAWLING BUG INSECTICIDES - AEROSOLS
CP			CARB MEDS		**1616**	CA1616	CPpesti6	DRAFT CONSUMER PRD: CRAWLING BUG INSECTICIDES - NON-AEROSOLS
CP			CARB MEDS		**1617**	CA1617	CPpesti7	DRAFT CONSUMER PRD: INSECTICIDE FOGGERS
CP			CARB MEDS		**1625**	CA1625	CPpesti8	DRAFT CONSUMER PRD: INSECT REPELLANTS - AEROSOLS
CP			CARB MEDS		**1635**	CA1635	CPclean1	DRAFT CONSUMER PRD: HOUSEHOLD CARPET AND UPHOLSTERY CLEANERS - AEROSO
CP			CARB MEDS		**1636**	CA1636	CPclean2	DRAFT CONSUMER PRD: HOUSEHOLD CARPET AND UPHOLSTERY CLEANERS - NON-AE
CP			CARB MEDS		**1638**	CA1638	CPclean3	DRAFT CONSUMER PRD: SPOT REMOVERS - AEROSOLS
CP			CARB MEDS		**1640**	CA1640	CPclean4	DRAFT CONSUMER PRD: FABRIC PROTECTANTS
CP			CARB MEDS		**1651**	CA1651	CPclean5	DRAFT CONSUMER PRD: GENERAL PURPOSE CLEANERS - AEROSOLS
CP			CARB MEDS		**1653**	CA1653	CPclean6	DRAFT CONSUMER PRD: GENERAL PURPOSE DEGREASERS - AEROSOLS
CP			CARB MEDS		**1654**	CA1654	CPclean7	DRAFT CONSUMER PRD: GENERAL PURPOSE DEGREASERS - NON-AEROSOLS
CP			CARB MEDS		**1655**	CA1655	CPclean8	DRAFT CONSUMER PRD: GLASS CLEANERS - AEROSOLS
CP			CARB MEDS		**1657**	CA1657	CPclean9	DRAFT CONSUMER PRD: METAL POLISHES/CLEANSERS
CP			CARB MEDS		**1658**	CA1658	CPclea10	DRAFT CONSUMER PRD: OVEN CLEANERS - AEROSOLS/PUMPS
CP			CARB MEDS		**1661**	CA1661	CPclea11	DRAFT CONSUMER PRD: BATHROOM AND TILE CLEANERS - AEROSOLS
CP			CARB MEDS		**1670**	CA1670	CPclea12	DRAFT CONSUMER PRD: LAUNDRY PREWASH - AEROSOLS/SOLIDS
CP			CARB MEDS		**1672**	CA1672	CPclea13	DRAFT CONSUMER PRD: LAUNDRY STARCHES, SIZINGS, ETC.
CP			CARB MEDS		**1680**	CA1680	CPclea14	DRAFT CONSUMER PRD: DUSTING AIDS - AEROSOLS
CP			CARB MEDS		**1681**	CA1681	CPclea15	DRAFT CONSUMER PRD: DUSTING AIDS - NON-AEROSOLS
CP			CARB MEDS		**1683**	CA1683	CPclea16	DRAFT CONSUMER PRD: NON-RESILIENT FLOOR WAX/POLISH
CP			CARB MEDS		**1684**	CA1684	CPclea17	DRAFT CONSUMER PRD: WOOD FLOOR WAX/POLISH
CP			CARB MEDS		**1685**	CA1685	CPclea18	DRAFT CONSUMER PRD: FURNITURE MAINTENANCE PRODUCTS - AEROSOLS
CP			CARB MEDS		**1686**	CA1686	CPclea19	DRAFT CONSUMER PRD: FURNITURE MAINTENANCE PRODUCTS - OTHER FORMS
CP			CARB MEDS		**1687**	CA1687	CPclea20	DRAFT CONSUMER PRD: SHOE CARE PRODUCTS
CP			CARB MEDS		**1700**	CA1700	CPlubr_1	DRAFT CONSUMER PRD: MULTI-PURPOSE LUBRICANT
CP			CARB MEDS		**1701**	CA1701	CPlubr_2	DRAFT CONSUMER PRD: SILICONE BASED MULTI-PURPOSE LUBRICANT
CP			CARB MEDS		**1702**	CA1702	CPlubr_3	DRAFT CONSUMER PRD: PENETRANT
CP			CARB MEDS		**1703**	CA1703	CPlubr_4	DRAFT CONSUMER PRD: SPECIALTY LUBRICANT
CP			CARB MEDS		**1710**	CA1710	CPaero_1	DRAFT CONSUMER PRD: SINGLE PHASE AEROSOL AIR FRESHENERS
CP			CARB MEDS		**1711**	CA1711	CPaero_2	DRAFT CONSUMER PRD: DOUBLE PHASE AEROSOL AIR FRESHENERS
CP			CARB MEDS		**1712**	CA1712	CPaero_3	DRAFT CONSUMER PRD: DUAL PURPOSE AIR FRESHENER/DISINFECTANT
CP			CARB MEDS		**1720**	CA1720	CPltrflu	DRAFT CONSUMER PRD: CHARCOAL LIGHTER MATERIALS
CP			CARB MEDS		**1721**	CA1721	CPaero_4	DRAFT CONSUMER PRD: AEROSOL COOKING SPRAYS
CP			CARB MEDS		**1730**	CA1730	CPaero_5	DRAFT CONSUMER PRD: UNDERARM ANTIPERSPIRANTS - AEROSOLS
CP			CARB MEDS		**1732**	CA1732	CPaero_6	DRAFT CONSUMER PRD: UNDERARM DEODORANTS - AEROSOLS
CP			CARB MEDS		**1760**	CA1760	CPaero_7	DRAFT CONSUMER PRD: HAIR SPRAY
CP			CARB MEDS		**1765**	CA1765	CPaero_8	DRAFT CONSUMER PRD: HAIR MOUSSES
CP			CARB MEDS		**1766**	CA1766	CPaero_9	DRAFT CONSUMER PRD: HAIR SHINES
CP			CARB MEDS		**1781**	CA1781	CPaero10	DRAFT CONSUMER PRD: SHAVING CREAMS
CP			CARB MEDS		**1782**	CA1782	CPaero11	DRAFT CONSUMER PRD: SHAVING GELS
CP			CARB MEDS		**1783**	CA1783	CPaero12	DRAFT CONSUMER PRD: FOOT POWDERS
CP			CARB MEDS		**1784**	CA1784	CPaero13	DRAFT CONSUMER PRD: PERSONAL HYGIENE SPRAYS
CP			CARB MEDS		**1792**	CA1792	CPclea21	DRAFT CONSUMER PRD: HEAVY DUTY HAND CLEANER OR SOAP
CP			CARB MEDS		**1799**	CA1799	CPcomp_1	DRAFT CONSUMER PRD: COMBINED SMALL CATEGORIES EPA COMPOSITE
COAT			CARB MEDS		**1800**	CA1800	Paint__1	DRAFT AEROSOL CTGS: CLEAR COATINGS (UNSPECIFIED)
COAT			CARB MEDS		**1801**	CA1801	Paint__2	DRAFT AEROSOL CTGS: FLAT COATINGS (UNSPECIFIED)
COAT			CARB MEDS		**1802**	CA1802	Paint__3	DRAFT AEROSOL CTGS: FLUORESCENT COATINGS

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
COAT			CARB MEDS		**1803**	CA1803	Paint__4	DRAFT AEROSOL CTGS: METALLIC PIGMENTED COATINGS
COAT			CARB MEDS		**1804**	CA1804	Paint__5	DRAFT AEROSOL CTGS: NONFLAT COATINGS (UNSPECIFIED)
COAT			CARB MEDS		**1805**	CA1805	Paint__6	DRAFT AEROSOL CTGS: PRIMERS (UNSPECIFIED)
COAT			CARB MEDS		**1806**	CA1806	Paint__7	DRAFT AEROSOL CTGS: ART FIXATIVES AND SEALANTS
COAT			CARB MEDS		**1807**	CA1807	Paint__8	DRAFT AEROSOL CTGS: AUTO BODY PRIMERS
COAT			CARB MEDS		**1808**	CA1808	Paint__9	DRAFT AEROSOL CTGS: AUTO BUMPER AND TRIM COATINGS
COAT			CARB MEDS		**1809**	CA1809	Paint_10	DRAFT AEROSOL CTGS: EXACT MATCH ENGINE ENAMEL
COAT			CARB MEDS		**1810**	CA1810	Paint_11	DRAFT AEROSOL CTGS: EXACT MATCH AUTOMOTIVE COATINGS
COAT			CARB MEDS		**1811**	CA1811	Paint_12	DRAFT AEROSOL CTGS: GROUND/TRAFFIC/MARKING COATINGS
COAT			CARB MEDS		**1812**	CA1812	Paint_13	DRAFT AEROSOL CTGS: HIGH TEMPERATURE COATINGS
COAT			CARB MEDS		**1813**	CA1813	Paint_14	DRAFT AEROSOL CTGS: VINYL/FABRIC/LEATHER/POLYCARB COATINGS
COAT			CARB MEDS		**1814**	CA1814	Paint_15	DRAFT AEROSOL CTGS: COATINGS (UNSPECIFIED)
COAT			CARB MEDS		**1901**	CA1901	Paint_16	DRAFT ARCHITECTURAL CTGS: SOLVENT BORNE (ARB 1998 SURVEY)
CP			CARB MEDS		**1930**	CA1930	PntThinr	THINNING SOLVENT/MINERAL SPIRITS (CALPOLY SLO 1996)
CP			CARB MEDS		**1941**	CA1941	CPadhesC	DRAFT CONSUMER PRD COMPOSITE: ADHESIVES AND SEALANTS
CP			CARB MEDS		**1942**	CA1942	CPautomC	DRAFT CONSUMER PRD COMPOSITE: AUTOMOTIVE PRODUCTS
CP			CARB MEDS		**1943**	CA1943	CPsolveC	DRAFT CONSUMER PRD COMPOSITE: SOLVENTS AND COATING RELATED PRDS
CP			CARB MEDS		**1944**	CA1944	CPpestiC	DRAFT CONSUMER PRD COMPOSITE: PESTICIDES/FIFRA-REGULATED PRDS
CP			CARB MEDS		**1945**	CA1945	CPhholdC	DRAFT CONSUMER PRD COMPOSITE: HOUSEHOLD PRODUCTS
CP			CARB MEDS		**1946**	CA1946	CPpersoC	DRAFT CONSUMER PRD COMPOSITE: PERSONAL CARE PRODUCTS
CP			CARB MEDS		**1947**	CA1947	CPcleanC	DRAFT CONSUMER PRD COMPOSITE: SOAPS AND DETERGENT PRODUCTS
COAT			CARB MEDS		**1949**	CA1949	SpryPntC	DRAFT AEROSOL COATINGS - OVERALL COMPOSITE
AM			CARB MEDS		**2000**	CA2000	LANM5-8	LA North Main 0500-0800 Ambient NMHC
AM			CARB MEDS		**2001**	CA2001	Azus5-8	Azusa 0500-0800 Ambient NMHC
AM			CARB MEDS		**2002**	CA2002	Burb5-8	Burbank 0500-0800 Ambient NMHC
AM			CARB MEDS		**2003**	CA2003	Fres5-8	Fresno 0500-0800 Ambient NMHC
AM			CARB MEDS		**2004**	CA2004	Hawt5-8	Hawthorne 0500-0800 Ambient NMHC
AM			CARB MEDS		**2005**	CA2005	Pico5-8	Pico Rivera 0500-0800 Ambient NMHC
AM			CARB MEDS		**2006**	CA2006	Sacr5-8	Sacramento 0500-0800 Ambient NMHC
AM	98	TX	CentralTexasHC		**2007**	AUST01	Bkgd_am_	Morning upwind background (composite of 00-06 samples from San Marcos), biogenics species removed
AM	98	TX	CentralTexasHC		**2008**	AUST02	Bkgd_pm_	Afernoon upwind background (composite of samples from McKinney Falls SP), biogenics species removed
AM	98	TX	CentralTexasHC		**2009**	AUST03	Bkgd_am	Morning upwind background (composite of 00-06 samples from San Marcos)
AM	98	TX	CentralTexasHC		**2010**	AUST04	Bio/Bkgd	Afernoon upwind background (composite of samples from McKinney Falls SP)
DE	92	MD	CentralTexasHC	2229	**2011**	AUST05	TuMchHD	Diesel Profile from Fort McHenry Tunnel in Baltimore, 1992
GE	98	TX	CentralTexasHC		**2012**	AUST06	CTMV01bd	Composite of CTMVFLbd (conjested freeway) and CTMVSR02bd (surface road, am), bkgd and diesel removed
COM	98	TX	CentralTexasHC		**2013**	AUST07	CTMV01	Composite of CTMVFLbd (conjested freeway) and CTMVSR02bd (surface road, am)
GE	98	TX	CentralTexasHC		**2014**	AUST08	CTMV02bd	Composite of CTMVFHbd (free-flow freeway) and CTMVSRpmbd (surface road, pm), bkgd and diesel removed
COM	98	TX	CentralTexasHC		**2015**	AUST09	CTMV02	Composite of CTMVFHbd (free-flow freeway) and CTMVSRpmbd (surface road, pm)
GE	98	TX	CentralTexasHC		**2016**	AUST10	CTMVFLbd	Composite of CTMVFL01and CTMVFL02, congested freeway, bkgd and diesel removed
COM	98	TX	CentralTexasHC		**2017**	AUST11	CTMVFL	Composite of CTMVFL01and CTMVFL02, congested freeway
GE	98	TX	CentralTexasHC		**2018**	AUST12	CTMVFHbd	Composite of CTMVFH01, CTMVFH02 and CTMVFH03, free-flow freeway, bkgd and diesel removed
COM	98	TX	CentralTexasHC		**2019**	AUST13	CTMVFH	Composite of CTMVFH01, CTMVFH02 and CTMVFH03, free-flow freeway
GE	98	TX	CentralTexasHC		**2020**	AUST14	CTMVSR02	Surface Road_S2 Downtown Austin on 20-Aug-98: 0700 to 0800, bkgd and diesel removed
AM	98	TX	CentralTexasHC		**2021**	AUST15	CTMVSR02	Surface Road_S2 Downtown Austin on 20-Aug-98: 0700 to 0800
GE	98	TX	CentralTexasHC		**2022**	AUST16	CTMVSRpm	Composite of CTMVSR01, CTMVSR03, and CTMVSR04, surface roads, bkgd and diesel removed
COM	98	TX	CentralTexasHC		**2023**	AUST17	CTMVSRpm	Composite of CTMVSR01, CTMVSR03, and CTMVSR04, surface roads
BIO	98	TX	CentralTexasHC		**2024**	AUST18	CTOD	Organic Decay_S1 Carrow's Restaurant I-35 & Koenig on 18-Aug-98: 0815 to 0915
NG	98	TX	CentralTexasHC		**2025**	AUST19	CTCNG	Natural Gas Composite of CTCNG01 and CTCNG02
NG	98	TX	CentralTexasHC		**2026**	AUST20	CTLPG01	Liquefied petroleum gas

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
GL	98	TX	CentralTexasHC		**2027**	AUST21	CTGASLCC	Gasoline, Liquid Composite, 68R12M20P
GL	98	TX	CentralTexasHC		**2028**	AUST22	CTGASLRC	Gasoline, Liquid Composite, Regular
GL	98	TX	CentralTexasHC		**2029**	AUST23	CTGASLMC	Gasoline, Liquid Composite, Mid-Grade
GL	98	TX	CentralTexasHC		**2030**	AUST24	CTGASLPC	Gasoline, Liquid Composite, Premium
GV	98	TX	CentralTexasHC		**2031**	AUST25	CTGASVCC	Gasoline, Vapor Composite, 68R12M20P
GV	98	TX	CentralTexasHC		**2032**	AUST26	CTGASVRC	Gasoline, Vapor Composite, Regular
GV	98	TX	CentralTexasHC		**2033**	AUST27	CTGASVMC	Gasoline, Vapor Composite, Mid-Grade
GV	98	TX	CentralTexasHC		**2034**	AUST28	CTGASVPC	Gasoline, Vapor Composite, Premium
SS			CentralTexasHC		**2035**	AUST40	A_PINENE	A_PINENE
SS			CentralTexasHC		**2036**	AUST41	B_PINENE	B_PINENE
SS			CentralTexasHC		**2037**	AUST42	ISOPENTA	ISOPENTANE
SS			CentralTexasHC		**2038**	AUST43	1-PENTEN	1-PENTENE
IP			NFRAQS		**2039**	MAH1	COOKING1	MeatCooking:_hamburger_auto-charbroil_1
IP			NFRAQS		**2040**	MAH2	COOKING2	MeatCooking:_hamburger_auto-charbroil_2
IP			NFRAQS		**2041**	MAN1	COOKING3	MeatCooking:_chicken_patties_auto-charbroil
IP			NFRAQS		**2042**	MCCc	COOKING4	MeatCooking:_chicken_charbroil
IP			NFRAQS		**2043**	MCH1	COOKING5	MeatCooking:_hamburger_charbroil
IP			NFRAQS		**2044**	MCK1	COOKING6	MeatCooking:_steak_charbroil
IP			NFRAQS		**2045**	MGHc	COOKING7	MeatCooking:_hamburger_griddle
IP			NFRAQS		**2046**	MGS1	COOKING8	MeatCooking:_sausage_griddle
RC			NFRAQS		**2047**	WFHc	FIREPLA1	Fireplace:_hardwood
RC			NFRAQS		**2048**	WFSc	FIREPLA2	Fireplace:_softwood
RC			NFRAQS		**2049**	WFSyn	FIREPLA3	Fireplace:_synthetic_log
RC			NFRAQS		**2050**	WSHc	WOODSTV1	Wood_stove:_hardwood
COAT	98		CentralTexasHC		**2051**	INK01_	ToyoInkM	ToyoInkMgfCoVariousInk
COAT	98		CentralTexasHC		**2052**	INK02_	PriscoA7	PriscoA766PowerkleneUK
COAT	98		CentralTexasHC		**2053**	INK03_	PriscoA2	PriscoA216Superklene2P
COAT	98		CentralTexasHC		**2054**	INK03r	PriscoA2	PriscoA216Superklene2P(reanalysis)
COAT	98		CentralTexasHC		**2055**	PNT01_	GlasUrit	GlasUrit_55PolyesterBasecoat
COAT	98		CentralTexasHC		**2056**	PNT02_	GlasUrit	GlasUrit_923-94HSClear
COAT	98		CentralTexasHC		**2057**	PNT03_	RM/Limco	RM/Limco_SupremeEnamelBasecoat
COAT	98		CentralTexasHC		**2058**	PNT04_	RM/Limco	RM/Limco_LC1300UrethaneClear
COAT	98		CentralTexasHC		**2059**	PNT05_	RM/Diamo	RM/Diamont_M6922PolyesterBasecoat
COAT	98		CentralTexasHC		**2060**	PNT06_	RM/Diamo	RM/Diamont_DC88DiamondClear
COAT	98		CentralTexasHC		**2061**	PNT07_	SherwinW	SherwinWilliamsB20W201ProMar200Exterior
COAT	98		CentralTexasHC		**2062**	PNT08_	SherwinW	SherwinWilliamsA82W596A-100ExteriorLatex
COAT	98		CentralTexasHC		**2063**	PNT09_	SherwinW	SherwinWilliamsA87W41SuperpaintInteriorLatex
COAT	98		CentralTexasHC		**2064**	PNT10_	Behr75In	Behr75InteriorEnamelUndercoat
COAT	98		CentralTexasHC		**2065**	PNT11_	Behr436E	Behr436ExteriorWaterbasedPrimerSealer
COAT	98		CentralTexasHC		**2066**	PNT12_	Behr3050	Behr3050InteriorSemiglossEnamel
COAT	98		CentralTexasHC		**2067**	PNT12r	Behr3050	Behr3050InteriorSemiglossEnamel(reanalysis)
COAT	98		CentralTexasHC		**2068**	PNT13_	Behr4560	Behr4560ExteriorFlat
BIO			SCAQS CMB		**2069**	PAM001	Biogenic	Biogenic - isoprene
COAT			CalPoly SLO-ARB		**2070**	PAM002	coat_cwf	clear wood finishes
COAT			CalPoly SLO-ARB		**2071**	PAM003	coat_ga	graphic arts coatings
COAT			CalPoly SLO-ARB		**2072**	PAM004	coat_imc	solvent based industrial maintenance coatings
COAT			CalPoly SLO-ARB		**2073**	PAM005	coat_m&hg	solvent based medium gloss/high gloss
COAT			CalPoly SLO-ARB		**2074**	PAM006	coat_p&e	quick dry primers and enamels
COAT			CalPoly SLO-ARB		**2075**	PAM007	coat_p&s	solvent based primers and sealers
COAT			CalPoly SLO-ARB		**2076**	PAM008	coat_sts	semi-transparent stains
COAT			CalPoly SLO-ARB		**2077**	PAM009	coat_tp	traffic paint
COAT			CalPoly SLO-ARB		**2078**	PAM010	coat_ts	thinning solvent
COAT			CalPoly SLO-ARB		**2079**	PAM011	coat_v	varnishes
COAT			CalPoly SLO-ARB		**2080**	PAM012	COATcomp	composite of coatings 2-11, weighted by total U.S. sales
COAT			SCAQS CMB		**2081**	PAM013	ACoat196	CARB Modeling Data System
COAT			SCAQS CMB		**2082**	PAM014	ICoat783	CARB Modeling Data System
NG	96	MX	Paso del Norte		**2083**	PAM016	CNG_J	Natural gas, Juarez
NG	96	TX	Paso del Norte		**2084**	PAM019	Prop_E	LPG from Super Energy Propane & Westex Conversion
NG	96	TX	Paso del Norte		**2085**	PAM020	Prop_J	LPG from Servigas & Commercial de Juarez
NG	72	SCAB	SCAQS CMB		**2086**	PAM015	CNG	Commercial Natural Gas from Los Angeles, Mayrsohn et al 1976
NG	72	SCAB	SCAQS CMB		**2087**	PAM017	GNG	Geogenic Natural Gas from Los Angeles, Mayrsohn et al 1976
NG	72	SCAB	SCAQS CMB		**2088**	PAM018	LPG	Liquefied Petroleum Gas from Los Angeles, Mayrsohn et al 1976
GL	95	MA	CRC CMB		**2089**	PAM022	Bogl01	Composite gasoline liquid from Boston, Summer 1995 Fed Phase 1 RFG
GL	95	SCAB	CRC CMB		**2090**	PAM023	LA_liqGs	Composite gasoline liquid from Los Angeles, Summer 1995 Fed Phase 1 RFG
GL		GA	IMP CMB paper		**2091**	PAM021	Atla_liq	Composite gasoline liquid from Atlanta SOS, Conventional
GL		MX	IMP CMB paper		**2092**	PAM024	Maga_liq	Magna Sin (unleaded)

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
GL		MX	IMP CMB paper		**2093**	PAM028	Nova_liq	Nova (leaded)
GL	96	MX	Paso del Norte		**2094**	PAM025	ME50R50P	50% Reg + 50% Pre Juarez
GL	96	MX	Paso del Norte		**2095**	PAM026	ME67R33P	67% Reg + 33% Pre Juarez
GL	96	MX	Paso del Norte		**2096**	PAM027	ME75R25P	75% Reg + 25% Pre Juarez
GL	96	TX	Paso del Norte		**2097**	PAM029	US681220	68%R+12%M+20%P El Paso
GL	96	WA	Washington		**2098**	PAM030	WA_Liq	Composite liquid gasoline from Seattle (5 brands, 3 grades), Conventional
GV	93	TX	COAST		**2099**	PAM034	HSkAD_D1	Astrodome, hot soak, downwind sample.
GV	93	TX	COAST		**2100**	PAM035	HSkAD_D2	Astrodome, hot soak, downwind sample.
GV	93	TX	COAST		**2101**	PAM036	HSkAD_DC	Composite of HSkAD_D1 and HSkAD_D2.
GV	93	TX	COAST		**2102**	PAM037	HSkAD_N1	Astrodome, hot soak, downwind-upwind.
GV	93	TX	COAST		**2103**	PAM039	HSvapGC	Composite of 14 gasoline head space vapor samples, HSvapG1 to HSvapG14
GV	95	MA	CRC CMB		**2104**	PAM032	BoGV01	Composite gasoline vapor from Boston, Summer 1995, Fed Phase 1 RFG
GV	95	SCAB	CRC CMB		**2105**	PAM040	LA_HSvap	Composite gasoline vapor from Los Angeles, Summer 1995
GV		GA	IMP CMB paper		**2106**	PAM031	Atla_HS	Composite gasoline vapor from Atlanta SOS, Conventional
GV		MX	IMP CMB paper		**2107**	PAM033	Diurnal	Diurnal Evaporative, Mexico City
GV		MX	IMP CMB paper		**2108**	PAM038	HSoak	Hot Soak, Mexico City
GV		MX	IMP CMB paper		**2109**	PAM041	Maga_HS	Maga Sin, Mexico City
GV		MX	IMP CMB paper		**2110**	PAM042	Nova_HS	Nova, Mexico City
GV	96	WA	Washington		**2111**	PAM043	WA_Vap	Composite from Seattle (5 brands, 3 grades)
IP	93	TX	COAST		**2112**	PAM044	BULK_plt	Composite of 5 emission profiles from miscellaneous industrial plants.
IP	93	TX	COAST		**2113**	PAM045	BULK_ter	Composite of 10 emission profiles from miscellaneous terminals.
IP	93	TX	COAST		**2114**	PAM049	CHmf_eth	Composite of 6 emission profiles from ethylene production facilities.
IP	93	TX	COAST		**2115**	PAM050	CHmf_fug	Composite of 3 fugitive emission profiles from chemical mfg. facilities.
IP	93	TX	COAST		**2116**	PAM052	HG0017W	Industrial point source, Amerada Hess, principle business: special warehousing a
IP	93	TX	COAST		**2117**	PAM053	HG0048L	Industrial point source, Lyondell Citgo Refining, principle business: petroleum
IP	93	TX	COAST		**2118**	PAM054	HG0076G	Industrial point source, Fabricated Metal Products.
IP	93	TX	COAST		**2119**	PAM055	HG0130C	Industrial point source, Phibro Energy, principle business: petroleum refining.
IP	93	TX	COAST		**2120**	PAM056	HG0176B	Industrial point source, Crown Central Petroleum, pri. business: bulk fuel stor
IP	93	TX	COAST		**2121**	PAM057	HG0188R	Industrial point source, Miles Incorporated, principle business: synthetic rubb
IP	93	TX	COAST		**2122**	PAM058	HG0225N	Industrial point source, Albermarle, principle business: industrial organic che
IP	93	TX	COAST		**2123**	PAM059	HG0261J	Industrial point source, GATX Terminals, principle business: bulk storage termin
IP	93	TX	COAST		**2124**	PAM060	HG0262H	Industrial point source, GATX Terminals, principle business: bulk storage termin
IP	93	TX	COAST		**2125**	PAM061	HG0312R	Industrial point source, Chevron, principle business: bulk fuel storage termin
IP	93	TX	COAST		**2126**	PAM062	HG0562P	Industrial point source, Texas Petrochem, pri. business: organic chemical synthe
IP	93	TX	COAST		**2127**	PAM063	HG0565J	Industrial point source, Phillips Pipeline, principle business: bulk fuel stor
IP	93	TX	COAST		**2128**	PAM064	HG0566H	Industrial point source, Phillips Chemical Company, pri. bus: K-Resin polymer pr
IP	93	TX	COAST		**2129**	PAM065	HG0669T	Industrial point source, South Coast Terminals, pri. business: petrochemical ta
IP	93	TX	COAST		**2130**	PAM066	HG0786O	Industrial point source, Warren Petroleum, principle business: bulk storage ter
IP	93	TX	COAST		**2131**	PAM067	IndAM_D1	Industrial cluster, Amoco, downwind sample.
IP	93	TX	COAST		**2132**	PAM068	IndAM_D2	Industrial cluster, Amoco, downwind sample.
IP	93	TX	COAST		**2133**	PAM069	IndAM_D3	Industrial cluster, Amoco, downwind sample.
IP	93	TX	COAST		**2134**	PAM070	IndAM_DC	Composite of IndAM_D1, IndAM_D2, and IndAM_D3.
IP	93	TX	COAST		**2135**	PAM071	IndSC_D1	Industrial cluster, Ship Channel, downwind sample.
IP	93	TX	COAST		**2136**	PAM072	IndSL_D1	Industrial cluster, Shell, downwind sample.
IP	93	TX	COAST		**2137**	PAM073	IndSL_D2	Industrial cluster, Shell, downwind sample.
IP	93	TX	COAST		**2138**	PAM074	IndSL_DC	Composite of IndSL_D1, IndSL_D2.
IP	93	TX	COAST		**2139**	PAM075	IndTX_D1	Industrial cluster, Texaco, downwind sample.
IP	93	TX	COAST		**2140**	PAM076	IndTX_D2	Industrial cluster, Texaco, downwind sample.
IP	93	TX	COAST		**2141**	PAM077	IndTX_DC	Composite of IndTX_D1, IndTX_D2.
IP	93	TX	COAST		**2142**	PAM078	IndTX_N1	Industrial cluster, Texaco, downwind-upwind sample.
IP	93	TX	COAST		**2143**	PAM079	IndUC_D1	Industrial cluster, Union Carbide, downwind sample.
IP	93	TX	COAST		**2144**	PAM080	IndUC_D2	Industrial cluster, Union Carbide, downwind sample.
IP	93	TX	COAST		**2145**	PAM081	IndUC_DC	Composite of IndUC_D1, IndUC_D2.
IP	93	TX	COAST		**2146**	PAM082	PEin_fug	Composite of 21 fugitive emission profiles from petroleum industry facilities.
IP	93	TX	COAST		**2147**	PAM083	PEma_fug	Composite of 5 fugitive emission profiles from petroleum marketing.
IP	93	TX	COAST		**2148**	PAM084	PEst_cru	Composite of 7 emission profiles from crude oil storage tanks.
IP	93	TX	COAST		**2149**	PAM085	PEst_dis	Composite of 9 emission profiles from dist. oil storage tanks.
IP	93	TX	COAST		**2150**	PAM086	PEst_fug	Composite of 15 fugitive emission profiles from petroleum storage facilities..
IP	93	TX	COAST		**2151**	PAM087	PEst_gas	Composite of 14 emission profiles from gasoline storage tanks.
IP	96	TX	Paso del Norte		**2152**	PAM046	ChevFC	Chevron FCC

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
IP	96	TX	Paso del Norte		**2153**	PAM047	ChevS	Chevron South
IP	96	TX	Paso del Norte		**2154**	PAM048	ChevT	Chevron TankFarm (Evap)
IP	96	TX	Paso del Norte		**2155**	PAM051	Delmex	Delmex
IP	96	TX	Paso del Norte		**2156**	PAM088	Zenco	Zenco
GE	88	US	Auto/Oil		**2157**	PAM089	ACComp	Current Fleet FTP Composite, Conventional Fuel
GE	88	US	Auto/Oil		**2158**	PAM090	ACCS	Current Fleet Cold Start
GV	88	US	Auto/Oil		**2159**	PAM091	ACDiurn	Current Fleet Diurnal Evaporative
GE	88	US	Auto/Oil		**2160**	PAM092	ACHS	Current Hot Start
GV	88	US	Auto/Oil		**2161**	PAM093	ACHsoak	Current Fleet Hot Soak Evaporative
GV	88	US	Auto/Oil		**2162**	PAM094	ACRunLs	Current Fleet Running Loss
GE	88	US	Auto/Oil		**2163**	PAM095	ACST	Current Fleet Hot Stabilized
GE	88	US	Auto/Oil		**2164**	PAM096	AOComp	Older Fleet FTP Composite
GE	88	US	Auto/Oil		**2165**	PAM097	AOCS	Older Fleet Cold Start
GV	88	US	Auto/Oil		**2166**	PAM098	AODiurn	Older Fleet Diurnal Evaporative
GV	88	US	Auto/Oil		**2167**	PAM099	AOHS	Older Fleet Hot Start
GV	88	US	Auto/Oil		**2168**	PAM100	AOHsoak	Older Fleet Hot Soak Evaporative
GE	88	US	Auto/Oil		**2169**	PAM101	AORunLs	Older Fleet Running Loss
GE	88	US	Auto/Oil		**2170**	PAM102	AOST	Older Fleet Hot Stabilized
VE	93	TX	COAST		**2171**	PAM105	CStAD_D1	Astrodome, cold start, downwind sample.
VE	93	TX	COAST		**2172**	PAM106	CStAD_D2	Astrodome, cold start, downwind sample.
VE	93	TX	COAST		**2173**	PAM107	CStAD_DC	Composite of CStAD_D1 and CStAD_D2.
VE	93	TX	COAST		**2174**	PAM108	CStAD_N1	Astrodome, cold start, downwind-upwind.
VE	93	TX	COAST		**2175**	PAM148	WRuBT_D1	Baytown Tunnel, warm running, downwind sample.
VE	93	TX	COAST		**2176**	PAM149	WRuWH_D1	Westheimer, warm running, downwind sample.
VE	93	TX	COAST		**2177**	PAM150	WRuWH_D2	Westheimer, warm running, downwind sample.
VE	93	TX	COAST		**2178**	PAM151	WRuWH_D3	Westheimer, warm running, downwind sample.
VE	93	TX	COAST		**2179**	PAM152	WRuWH_D4	Westheimer, warm running, downwind sample.
VE	93	TX	COAST		**2180**	PAM153	WRuWH_DC	Composite of WRuWH_D1, WRuWH_D2, WRuWH_D3, and WRuWH_D4.
VE	93	TX	COAST		**2181**	PAM154	WRuWH_N1	Westheimer, warm running, downwind-upwind.
VE	93	TX	COAST		**2182**	PAM155	WRuWH_N2	Westheimer, warm running, downwind-upwind.
VE	93	TX	COAST		**2183**	PAM156	WRuWH_NC	Composite of WRuWH_N1, WRuWH_N2.
GE	95	MA	CRC CMB		**2184**	PAM103	BoCS_Tip	Tip O'Neill Garage Cold Start
GE	95	MA	CRC CMB		**2185**	PAM125	Tu_Cal0	Callahan Tunnel diesel exhaust subtracted
GE	95	MA	CRC CMB		**2186**	PAM126	Tu_Cal1	Callahan Tunnel diesel and minimum running loss subtracted
GE	95	MA	CRC CMB		**2187**	PAM127	Tu_Cal2	Callahan Tunnel diesel and maximum running loss subtracted
GE	95	NY	CRC CMB		**2188**	PAM129	Tu_Lin0	Lincoln Tunnel diesel exhaust subtracted
GE	95	NY	CRC CMB		**2189**	PAM130	Tu_Lin1	Lincoln Tunnel diesel and minimum running loss subtracted
GE	95	NY	CRC CMB		**2190**	PAM131	Tu_Lin2	Lincoln Tunnel diesel and maximum running loss subtracted
GE	95	SCAB	CRC CMB	2225	**2191**	PAM135	Tu_Sep0	Sepulveda Tunnel diesel exhaust subtracted
GE	95	SCAB	CRC CMB		**2192**	PAM136	Tu_Sep1	Sepulveda Tunnel diesel and minimum running loss subtracted
GE	95	SCAB	CRC CMB		**2193**	PAM137	Tu_Sep2	Sepulveda Tunnel diesel and maximum running loss subtracted
GE	95	SCAB	CRC CMB		**2194**	PAM141	Tu_Van0	Van Nuys Tunnel diesel exhaust subtracted
GE	95	SCAB	CRC CMB		**2195**	PAM142	Tu_Van1	Van Nuys Tunnel diesel and minimum running loss subtracted
GE	95	SCAB	CRC CMB		**2196**	PAM143	Tu_Van2	Van Nuys Tunnel diesel and maximum running loss subtracted
VE	95	MA	CRC Tunnel		**2197**	PAM124	Tu_Cal	Callahan Tunnel
VE	95	NY	CRC Tunnel		**2198**	PAM128	Tu_Lin	Lincoln Tunnel
DE	92	MD	FMH tunnel	2229	**2199**	PAM132	Tu_MchHD	Fort McHenry Tunnel Diesel
GE	92	MD	CRC Tunnel		**2200**	PAM133	Tu_MchLD	Fort McHenry Tunnel Light Duty Gasoline
VE	95	SCAB	CRC Tunnel		**2201**	PAM134	Tu_Sep	Sepulveda Tunnel
DE	92	PA	CRC Tunnel		**2202**	PAM138	Tu_TusHD	Tuscarora Tunnel Diesel
GE	92	PA	CRC Tunnel		**2203**	PAM139	Tu_TusLD	Tuscarora Tunnel Light Duty Gasoline
VE	95	SCAB	CRC Tunnel		**2204**	PAM140	Tu_Van	Van Nuys Tunnel
GE		MX	IMP CMB paper		**2205**	PAM104	ColdSt	Cold Start from garage measurements in Mexico City
VE		MX	IMP CMB paper		**2206**	PAM111	Exh_Tun	Tunnel in Mexico City
GE	96	MX	Paso del Norte		**2207**	PAM109	Exh_J	Juarez rush hour traffic
VE	96	MX	Paso del Norte		**2208**	PAM110	Exh_PBa	Juarez propane bus - adjusted for Juarez traffic
GE			SCAQMD Orange Co		**2209**	PAM113	OCHiComp	100% high emitters
GE			SCAQMD Orange Co		**2210**	PAM114	OCL10H90	90% high and 10% low emitters
GE			SCAQMD Orange Co		**2211**	PAM115	OCL20H80	80% high and 20% low emitters
GE			SCAQMD Orange Co		**2212**	PAM116	OCL30H70	70% high and 30% low emitters
GE			SCAQMD Orange Co		**2213**	PAM117	OCL40H60	60% high and 40% low emitters
GE			SCAQMD Orange Co		**2214**	PAM118	OCL50H50	50% high and 50% low emitters
GE			SCAQMD Orange Co		**2215**	PAM119	OCL60H40	40% high and 60% low emitters
GE			SCAQMD Orange Co		**2216**	PAM120	OCL70H30	30% high and 70% low emitters
GE			SCAQMD Orange Co		**2217**	PAM121	OCL80H20	20% high and 80% low emitters
GE			SCAQMD Orange Co		**2218**	PAM122	OCL90H10	90% high and 10% low emitters
GE			SCAQMD Orange Co		**2219**	PAM123	OCLoComp	100% low emitters

Appendix B
VOC Source Composition Profile Library

Category	year	location	DataSource	same as	INDEX#	profile code	Profile	Description
GE	82	US	SCAQS CMB		**2220**	PAM112	Exh801a	EPA 46-car Study
VE	96	WA	Washington		**2221**	PAM144	WA_Tu	Mt. Baker Tunnel emissions, downwind exhaust.
GE	96	WA	Washington		**2222**	PAM145	WA_Tu0	Mt. Baker Tunnel emissions with diesel contributions removed.
GE	96	WA	Washington		**2223**	PAM146	WA_Tu1	Mt. Baker Tunnel emissions with diesel and 5~10% of running loss contributions r
GE	96	WA	Washington		**2224**	PAM147	WA_Tu2	Mt. Baker Tunnel emissions with diesel and 15~30% of running loss contributions
GE	95	SCAB	CRC CMB		**2225**	TUN001	TuS95	Sepulveda Tunnel, diesel subtracted, 1995
GE	96	SCAB	CRC CMB		**2226**	TUN002	TuS96	Sepulveda Tunnel, diesel subtracted, 1996
GE	96	SCAB	CRC CMB	2226	**2227**	TUN003	TuS96lo	Sepulveda Tunnel, diesel subtracted, lo-speed traffic 1996
GE	96	SCAB	CRC CMB	2226	**2228**	TUN004	TuS96hi	Sepulveda Tunnel, diesel subtracted, hi-speed traffic 1996
DE	92	MD	CRC Tunnel		**2229**	TUN005	TuMchHDc	Diesel Profile (incl carbonyls), Ft McHenry Tunnel, Baltimore, 1992
COAT		SCAB	SCOS97		**2230**	InkPic	PicoInk1	Ink from print shop near Pico Rivera Site
AM		SCAB	SCOS97		**2232**	PtConc	BkgPtCon	Point Conception Ambient 8/11-10/4/97
AM		SCAB	SCOS97		**2233**	SanNic	BkgSnNic	San Nicolas Island Ambient 7/14-10/4/97
AM		SCAB	SCOS97		**2234**	Catlna	BkgCatal	Catalina Isl Ambient 8/4-10/3/97
AM		SCAB	SCOS97		**2235**	BkgAM1	PtConcAM	Point Conception Ambient 0600 8/11-10/4/97
AM		SCAB	SCOS97		**2236**	BkgPM1	PtConcPM	Point Conception Ambient 1800 8/11-10/4/97
AM		SCAB	SCOS97		**2237**	BkgAM2	SNicIsAM	San Nicolas Island Ambient 0600 7/14-10/4/97
AM		SCAB	SCOS97		**2238**	BkgPM2	SNicIsPM	San Nicolas Island Ambient 1800 7/14-10/4/97
AM		SCAB	SCOS97		**2239**	BkgAM3	CatlnaAM	Catalina Isl Ambient 0600 8/4-10/3/97
AM		SCAB	SCOS97		**2240**	BkgPM3	CatlnaPM	Catalina Isl Ambient 1800 8/4-10/3/97
AM		SCAB	SCOS97		**2241**	BkgAMc	BkgAMcom	Composite bkgrd ambient for SoCal 0600 summer 97 - Isoprene removed
AM		SCAB	SCOS97		**2242**	BkgPMc	BkgPMcom	Composite bkgrd ambient for SoCal 1800 summer 97 - Isoprene removed
SS			DRI		**2243**	UNID	UNID	Unidentified Species
DE	1	CA	EC diesel		**2244**	ECDsl1	SchoolBs	SchoolBusCSHVR,CARBfuel,bkgd subtr.
DE	1	CA	EC diesel		**2245**	ECDsl2	HDDtruck	GroceryTruckCSHVR,CARBfuel,bkgd subtr.
DE	1	CA	EC diesel		**2246**	ECDsl3	TrnstBus	TransitBusCSHVR,CARBfuel,bkgd subtr.
DE	1	CA	EC diesel		**2247**	ECDcom	DieslCom	Composite of 3 diesel vehicles
DE	0	SCAB	WE/WD ozone		**2248**	WEOz01	WEOzHDD1	TruckStop@jxn I10 and I15 bkgd subtr. scaled to MTBE
GE	0	SCAB	WE/WD ozone		**2249**	WEOz02	WEOzLDV1	avg of Pasadena Fwy samples - bkgd subtr.
GL	0	SCAB	WE/WD ozone		**2250**	WEOz03	ArcoReg	Gas 1 ArcoReg
GL	0	SCAB	WE/WD ozone		**2251**	WEOz04	ArcoPrem	Gas 2 ArcoPrem
GL	0	SCAB	WE/WD ozone		**2252**	WEOz05	U76Prem	Gas 3 U76Prem
GL	0	SCAB	WE/WD ozone		**2253**	WEOz06	4 U76Reg	Gas 4 U76Reg
GL	0	SCAB	WE/WD ozone		**2254**	WEOz07	MobilPre	Gas 5 MobilPre
GL	0	SCAB	WE/WD ozone		**2255**	WEOz08	MobilReg	Gas 6 MobilReg
GL	0	SCAB	WE/WD ozone		**2256**	WEOz09	ShellPre	Gas 7 ShellPre
GL	0	SCAB	WE/WD ozone		**2257**	WEOz10	ShellReg	Gas 8 ShellReg
GL	0	SCAB	WE/WD ozone		**2258**	WEOz11	ChevPrem	Gas 9 ChevPrem
GL	0	SCAB	WE/WD ozone		**2259**	WEOz12	ChevReg	Gas 10 ChevReg
GL	0	SCAB	WE/WD ozone		**2260**	WEOz13	LiqGasAv	LiqGasComposite
DE	0	SCAB	WE/WD ozone		**2261**	WEOz14	diesel#1	Diesel Fuel sample 1
DE	0	SCAB	WE/WD ozone		**2262**	WEOz15	diesel#2	Diesel Fuel sample 2
DE	0	SCAB	WE/WD ozone		**2263**	WEOz16	diesel_C	Diesel Fuel composite
GL	0	SCAB	WE/WD ozone		**2264**	WE003	Gas00LRPC	Composite liquid 68% Reg/32% Prem, WE Study 2000
GV	0	SCAB	WE/WD ozone		**2265**	WE006	Gas00VRPC	Composite vapor 68% Reg/32% Prem, WE Study 2000