REQUEST FOR QUOTATION

March 5, 2010

PROJECT: **Analysis of Non-Methane Organic Compounds**

QUOTES DUE BY: **5:00 PM on Friday, March 19, 2010**

OVERVIEW

The San Joaquin Valley Unified Air Pollution Control District (District) is participating in the United States Environmental Protection Agency (USEPA) Enhanced Photochemical Assessment Monitoring Station (PAMS) monitoring program. Part of this program involves sampling for non-methane organic compounds (NMOC) adhering to the most current USEPA PAMS Technical Assistance Document (TAD), using SUMMA stainless steel canisters. The District is issuing this Request for Quotation (RFQ) in order to retain a qualified contractor who will analyze samples collected in 2010 and possibly 2011, report the results in a timely manner and in prescribed formats, and follow the other project specifications listed below.

Only contractors who have successfully completed similar PAMS analyses for a state or local air quality agency within the last two years will be considered for this project. Contractors who do not currently meet this prerequisite are encouraged to solicit contracts from other state and local agencies, in order to qualify in future years.

The District will pay on a per canister basis, and will fully pay for services rendered only when required performance audits are completed successfully as established by the contractual agreement. The District will retain 20% from each monthly invoice. This 20% retention will be paid when the audits are passed, and after the data is successfully loaded into AQS.

In order for a contractor to be eligible for award of this contract, the contractor must not presently be debarred, suspended, proposed for debarment, declared ineligible, voluntarily excluded from participation or otherwise excluded from or ineligible for participation under federal assistance programs. Should a contractor be awarded a contract, the signing of a non-debarment certification will be required.

The District reserves the right to reject any and all quotations, and to make no awards.

SUBMITTAL INSTRUCTIONS

A contractor who submits a quotation in response to this RFQ must adhere to the following instructions:

1. The deadline for submitting quotations is 5:00 PM on Friday, March 19, 2010. Quotations received after this time and date will not be accepted.

2. Quotations are to be mailed to the following address:

   San Joaquin Valley Unified Air Pollution Control District
   Attn: Mr. Jon Klassen
   Air Quality Specialist
   1990 E. Gettysburg Avenue
   Fresno, CA 93726-0244

3. The envelope should be marked with title "Quotation for Analysis of Non-Methane Organic Compounds."

4. Include five (5) hard copies and one (1) electronic copy of the quotation.

QUOTATION REQUIREMENTS

At a minimum, submitted quotations are to:

1. Not exceed 24 pages in length (including cover letter and reference material).

2. Describe previous experience in the documentation and analysis of PAMS canisters (references and/or letters of recommendation are required).

3. Provide qualifications of contractor staff who will be assigned to this project, and describe the role of each assigned staff member to be used in the project.

4. Describe the process that the contractor will use in the analyses of the samples.

5. Describe previous experience in the usage of the EPA-AIRS data format.

6. Describe previous experience with the most current USEPA PAMS TAD for PAMS VOC Target Species.

7. Include an example of the reports that will be submitted during the course of this project.

8. Include a price quote for the analysis of the pre-contract award audit sample and performance evaluation (explained below).

9. Include a price quote for each of the following items on a per canister basis:
    a. The cost of analysis of the canisters;
    b. The evacuation, cleaning, and certification of sample canisters;
    c. The repairing of canisters; and
    d. Documentation of invalid samples and missing sample runs.

GENERAL PROJECT GUIDELINES

The following is a description of the general project guidelines, requirements, and responsibilities that both the District and contractor will hold during the life of the project:

1. The contract for this project will cover the 2010 PAMS season, with an option for renewal for the 2011 PAMS season. This option will only be exercised if:
    - the contractor has met the performance requirements of the District, and
    - the District will have the funding available for the 2011 PAMS season.

2. Before the award of a contract, the contractor shall successfully complete an analysis of an audit sample in order for the District to evaluate the performance of the lab. A contract shall not be awarded if this performance evaluation audit is not passed. The performance evaluation is considered passed if the measurement of each compound is within ±25% of the known value. The results of the sample audit analysis must be submitted by March 31, 2010.

3. In 2010, there will be approximately 746 samples sent to the contractor for analysis, depending on the number of samples collected. PAMS sampling will be conducted during the months of June, July and August of 2010, and preseason sampling is planned to be conducted in April and May.

4. The District will supply the NMOC samples in 6L SUMMA stainless steel canisters owned by the District.

5. The contractor shall perform NMOC analyses using the USEPA Method TO-14A.

6. The contractor will make any needed repairs to the canisters such as valve or gauge replacement. Payment for any such repairs shall be in accordance with the contract.

7. The contractor will be available by phone to discuss issues related to this project during the same business day that the District places the call with the contractor. The contractor shall notify the District immediately upon the discovery of any irregularities during the course of the project.

8. The contractor shall retain and archive a copy of all paper and electronic records of this project for a minimum of three (3) years. The archived records will include any documentation pertaining to the analysis and reduction of raw and processed data, including calibrations, samples and run sequences. In the case where there is a need of clarification or investigation of the reported data, the contractor will provide any and all necessary information as requested so that the entire analysis can be reconstructed.

9. If the contractor prefers that the collected samples be returned to them using a specific kind of container, other than what the District proposes to use, then the contractor must supply these materials to the District as part of the contract. The containers/shipping materials must meet all of Department of Transportation and Federal Aviation Administration requirements for safe handling and transport provided by shipping companies like UPS or FedEx. If the contractor desires the District to use a particular written form for tracking the exposed sample (i.e. a chain of custody (COC) form), the contractor will supply a sufficient quantity of these forms for use by District staff.

10. The District is responsible for all shipping costs of canisters (including audit samples) sent to the District and/or returned to the contractor for this job. The contractor shall be responsible for the shipping cost of canisters that are returned to the District with unacceptable conditions, such as less than -20 PSI of vacuum, missing fitting caps, or with a broken gauge. The certification tag shall include a check list for these items.

11. The contractor is to have general liability insurance for at least One Million Dollars ($1,000,000.00) for bodily or personal injuries or for property damage as well as Workers Compensation Insurance in accordance with the California Labor Code.

QUALITY CONTROL

The following procedures will be employed to ensure the quality of the project and the resulting data:

1. The contractor is to provide their own certified EPA-PAMS Reference Gas Cylinder for calibration standard purposes. The Gas Cylinder must include the PAMS VOC Target Species. These gases must be traceable to a NIST standard.

2. Samples shall be promptly analyzed to prevent degradation of the hydrocarbon species, and to facilitate timely return of the canisters to the District. The contractor shall return the canisters within ten (10) days upon receiving them. Delays in returning canisters will be subject to financial penalties, as specified in the contract.

3. The contractor will analyze contents of only the valid samples as identified in District chain of custody (COC) forms. The contractor will not analyze contents of invalid samples. For invalid samples, the contractor will repair canisters as necessary, and prepare, clean, and certify canisters for subsequent sampling. The contractor will appropriately document missing samples.

4. Upon completion of analysis, the contractor will evacuate, clean, and certify each canister for future sampling and analysis before returning it to the District. Preparation shall include cleaning the canister, vacuum verification of -30 PSI and leak testing. Canisters received with less than the -20 PSI will be deemed defective with a leak problem and returned for correction at the contractor's expense.

5. The contractor will analyze and include in the reports one (1) clean and certified canister per day as a part of the quality control certification process.

6. The contractor will provide written documentation indicating the methodology used for analytical instrument calibration, analysis and quality control / assurance. Copies of all related paperwork used to conduct data analysis such as chromatograms; instrument calibrations, etc., shall be supplied to the District as a hard copy and in electronic PDF form.

7. At no additional cost the contractor will analyze for audit purposes, any canister(s) sent to the contractor by a CARB, USEPA and/or EPA approved NATTS Laboratory designated by the District. The contractor shall provide copies of these audit results to the District. The results shall include all pertinent information regarding calibration reports and standard certificates.

DATA REQUIREMENTS

The following is a list of requirements for the collection and reporting of the data involved in this project:

1. The contractor will only report data according to the EPA's list of VOC Target Species for PAMS. PAMS VOC Target Species for analyses and AIRS code numbers are listed at the end of this RFQ.

2. Laboratory equipment must be capable of detecting and measuring levels of VOCs as low as one (1) PPBc.

3. Reported data is to meet Level IV criteria according to EPA guidelines for PAMS documentation.

4. Data is to be reported in both PPBv and PPBc.

5. The data formatted for upload to the AIRS database is to utilize PPBc.

6. The contractor will submit monthly reports summarizing the analyzed data during the course of the project.

7. The contractor will provide the resulting data in 3 forms:
   a. Electronic AIRS file format;
   b. Compact Disc individually labeled per site and per month; and
   c. Hard copy printouts in 4-inch binders, tab separated and labeled per trend or episode batch. Each batch report must identify the station name, station AIRS code, and sample date.

8. The completed data file is to be submitted to the District **no later than October 31, 2010.** In accordance with the contract, data submittal delay and format problems will be subject to financial penalties. The contractor is responsible for QC/QA of the AIRS files. Files that do not correctly upload will be returned to the contractor for revision.

INQUIRIES

Technical and administrative questions concerning this RFQ should be directed to Mr. Jon Klassen, Air Quality Specialist, San Joaquin Valley Unified Air Pollution Control District at jon.klassen@valleyair.org or (559) 230-6000.

Sampling and Analysis Summary Information for PAMS VOC Target Species

See Methods for VOCs on Next Page

Number of VOC Compounds = 60

	Compound Name	IUPAC Name (if different)	Group Designation (note 1)	AIRS Parameter Number (note 1)	Boiling Point (degrees C) (note 2)	Volatility	CAS Number (note 2)	Sampling Method Alternatives (note 3)	Separator (note 4)	Detector (note 5)	EPA Ref. Desig. For Current Method (note 6)	Detection Limit (ppbv) (note 6)	Alternative Methods (possibly lower cost) (note 6)
1	Ethane		paraffin	43202	-88.5	Very vol.	74-84-0	Multi-adsorbent	GC	MS	TO-17	0.2-25	No alternative
2	Propane		paraffin	43204	-42	Very vol.	74-98-6	Multi-adsorbent	GC	MS	TO-17	0.2-25	No alternative
3	Isobutane	2-Methylpropane	paraffin	43214	-12	Very vol.	75-28-5	Can+ads or Can	GC	MS/FID	TO-15	0.2-25	TO-14A
4	n-Butane		paraffin	43212	0	Very vol.	106-97-8	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
5	Isopentane	2-Methylbutane	paraffin	43221	28	Very vol.	78-78-4	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
6	n-Pentane		paraffin	43220	36	Very vol.	109-66-0	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
7	Cyclopentane		paraffin	43242	49	Very vol.	287-92-3	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
8	2,2-Dimethylbutane		paraffin	43244	50	Med. vol.	75-83-2	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
9	2,3-Dimethylbutane		paraffin	43284	58	Med. vol.	79-29-8	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
10	2-Methylpentane		paraffin	43285	60	Med. vol.	107-83-5	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
11	3-Methylpentane		paraffin	43230	63	Med. vol.	96-14-0	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
12	n-Hexane		paraffin	43231	69	Med. vol.	110-54-3	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
13	Methylcyclopentane		paraffin	43262	72	Med. vol.	96-37-7	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
14	Cyclohexane		paraffin	43248	81	Med. vol.	110-82-7	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
15	2,4-Dimethylpentane		paraffin	43247	81	Med. vol.	108-08-7	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
16	2-Methyl hexane		paraffin	43263	90	Med. vol.	591-76-4	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
17	2,3-Dimethylpentane		paraffin	43291	90	Med. vol.	565-59-3	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
18	3-Methylhexane		paraffin	43249	92	Med. vol.	6131-24-4	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
19	2,2,4-Trimethylpentane		paraffin	43250	99	Med. vol.	540-84-1	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
20	n-Heptane		paraffin	43232	99	Med. vol.	142-82-5	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
21	Methylcyclohexane		paraffin	43261	101	Med. vol.	108-87-2	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
22	2,3,4-Trimethylpentane		paraffin	43252	114	Med. vol.	565-75-3	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
23	2-Methylheptane		paraffin	43960	118	Med. vol.	592-27-8	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
24	3-Methylheptane		paraffin	43253	119	Med. vol.	6131-25-5	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
25	n-Octane		paraffin	43233	126	Less vol.	111-65-9	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
26	n-Nonane		paraffin	43235	151	Less vol.	111-84-2	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
27	n-Decane		paraffin	43238	174	Less vol.	124-18-5	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
28	n-Undecane		paraffin	43954	196	Less vol.	1120-21-4	Can+ads/can	GC	MS/FID	TO-15	0.2-25	TO-14A
29	n-Dodecane		paraffin	43141	217	Less vol.	112-40-3	Can+ads	GC	MS	TO-15	0.2-25	No alternative
1	Acetylene	Ethyne	alkyne	43206	-85	Very vol.	74-86-2	Multi-adsorbent	GC	MS	TO-17	0.2-25	No alternative
1	Ethylene	Ethene	olefin	43203	-104	Very vol.	74-85-1	Multi-adsorbent	GC	MS	TO-17	0.2-25	No alternative
2	Propylene	1-Propene	olefin	43205	-48	Very vol.	115-07-1	Multi-adsorbent	GC	MS	TO-17	0.2-25	No alternative
3	1-Butene		olefin	43280	-6	Very vol.	106-98-9	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
4	trans-2-Butene		olefin	43216	1	Very vol.	624-64-6	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
5	cis-2-Butene		olefin	43217	4	Very vol.	590-18-1	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
6	1-Pentene		olefin	43224	30	Very vol.	109-67-1	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
7	Isoprene	2-Methyl-1,3-butadiene	olefin	43243	34	Very vol.	78-79-5	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
8	trans-2-Pentene		olefin	43226	36	Very vol.	646-04-8	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
9	cis-2-Pentene		olefin	43227	37	Very vol.	627-20-3	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
10	1-Hexene		olefin	43245	63	Med vol.	592-41-6	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
1	Benzene		aromatic	45201	80	Med. vol.	71-43-2	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
2	Toluene	Methyl-benzene	aromatic	45202	111	Med. vol.	108-88-3	Can+ads/can/CMS	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-2
3	Ethylbenzene		aromatic	45203	136	Less vol.	100-41-4	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
4	meta-Xylene	1,3-Methyl-benzene	aromatic	45109	139	Less vol.	108-38-3	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
5	para-Xylene	1,4-Methyl-benzene	aromatic	45109	138	Less vol.	106-42-3	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
6	Styrene	Ethenyl-benzene	aromatic	45220	145	Less vol.	100-42-5	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
7	ortho-Xylene	1,2-Methyl-benzene	aromatic	45204	145	Less vol.	95-47-6	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
8	Isopropylbenzene (cumene)	1-Methyl-ethyl-benzene	aromatic	45210	152	Less vol.	98-82-8	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
9	n-propylbenzene	Propyl-benzene	aromatic	45209	159	Less vol.	103-65-1	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
10	m-Ethyltoluene	1-Ethyl-3-methyl-benzene	aromatic	45212	161	Less vol.	620-14-4	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
11	p-Ethyltoluene	1-Ethyl-4-methyl-benzene	aromatic	45213	162	Less vol.	622-96-8	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
12	1,3,5-Trimethylbenzene		aromatic	45207	165	Less vol.	108-67-8	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
13	o-Ethyltoluene	1-Ethyl-2-methyl-benzene	aromatic	45211	165	Less vol.	611-14-3	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
14	1,2,4-Trimethylbenzene		aromatic	45208	169	Less vol.	95-63-6	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
15	1,2,3-Trimethylbenzene		aromatic	45225	176	Less vol.	526-73-8	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
16	m-Diethylbenzene	1,3-Diethyl-benzene	aromatic	45218	181	Less vol.	141-93-5	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
17	p-Diethylbenzene	1,2-Diethyl-benzene	aromatic	45219	184	Less vol.	105-05-5	Can+ads/can/cryog.	GC	MS/FID	TO-15	0.2-25	TO-14A/TO-3
1	Acetaldehyde	Ethanal	oxidized alcohols	43503	20	Very vol.	75-07-0	Cartridge/Liquid Impinger	HPLC	UV	TO-11A	0.5-100	TO-5
2	Acetone	2-Propanone	oxidized alcohols	43551	56	Med. vol.	67-64-1	Cartridge/Liquid Impinger	HPLC	UV	TO-11A	0.5-100	TO-5
3	Formaldehyde	Methanal	oxidized alcohols	43502	-20	Very vol.	50-00-0	Cartridge/Liquid Impinger	HPLC	UV	TO-11A	0.5-100	TO-5

note 1: See lists and discussion in " Technical Assistance Document for Sampling and Analysis of Ozone Precursors" EPA/600-R-98/161 (USEPA, Human Exposure and Atmospheric Sciences Division, Research Triangle Park, North Carolina. September, 1998, Section 2, pp. 5-7.

note 2: Boiling Points and CAS numbers are found in "CRC Handbook of Chemistry and Physics," 79th Edition, D. R. Lide, ed., Boca Raton, January, 1998, Section 3, pp. 3-1 ff.

note 3: At a simple level, sampling procedures fall into either cannister techniques or adsorbent techniques. But the five methods, TO2,3,14A,15 and 17, provide for alternatives within these two categories. In addition, adsorbents vary with respect to breakthrough limits and VOC volatilities. The abbreviations shown include: Can = cannister of any type, CMS = carbon molecular sieve adsorbent, Cry = cryogenic concentration technique (types vary), Ads = adsorbent of type other than CMS, including multisorbent tubes. Generally, it is assumed that most cannister sampling methods are more costly than most adsorbent methods. However, complex multi-adsorbent cartridges can be costly.

note 4: Gas chromatograph is the designated separation method for both mass spectrometer and flame ionization methods.

note 5: Although mass spectrometer is the method of detection given for the most recent EPA methods, flame ionization is shown as an alternative detector for Methods TO-14A and TO-2.

note 6: Detailed descriptions of methods TO-1 through TO-17 are shown at http://www.epa.gov/ttn/amtic/airtox.html.

METHODS FOR PAMS VOCs (note 1)

See VOC Species Information on Previous Page

Method Designation	Collector	Analyzer	Detector	Volatility category that method best matches (note 2)	Boiling pt. range (C) (note 1)	Most Appropriate Compounds	Detection limit (ppbv)	Cost comments and ratings: 1 = least costly (note 3)	Procedural Steps in Methods: 1. Sample Collection	2. Sample Treatment	3. Sample Transfer	4. Separation	5. Detection, Identification, and Measurement
TO-1	Tenax cartridge	GC	MS	Less volatile	80 to 200	aromatic hydrocarbons, benzene, toluene, and xylene	0.01 to 100	2: MS is costly, but no cannister required	1. Collect sample by drawing ambient air through Tenax cartridge.	2. Return to lab. Heat cartridge and purge with inert gas.	3. Transfer VOCs to cryog. trap, then heat trap for insertion of VOCs into GC.	4. Hold GC column at low temperature, then heat as VOCs are introduced.	5. Separate by GC and identify and measure by MS. ECD and FID are mentioned, but not identified as part of this method.
TO-2	Carbon molecular sieve cartridge	GC	MS FID	Medium volatile	-15 to 120	benzene, toluene	0.1 to 200	1: FID not as costly as MS, and no cannister req.	1. Collect sample by drawing ambient air through CMS cartridge.	2. Return to lab and purge water vapor from cartridge with dry air and heated helium.	3. Transfer VOCs to cryog. loop (trap), then heat trap for insertion of VOCs into GC.	4. Hold GC column at low temperature, then heat as VOCs are introduced.	5. Separate by GC and identify and measure by MS. FID is identified as a possibly preferable for this method.
TO-3	Cryogenic cannister	GC	FID	Medium volatile	-10 to 200	many VOCS	0.1 to 200	2: Cryog. cannister system raises cost, but FID cheaper than MS	1. Collect sample by drawing ambient air directly into cryog. trap (container), e.g., immersed in liquid argon.	2. May use Nafion or other dryer before air goes into cryog. container.	3. No intermediate transfer.	4. Cryog. cont. intake valve is switched to GC column injection, possibly on site. Cont. is heated to 150 deg C.	5. Identify and measure compounds by FID (provides det. limits of 1 to 5 ng for many compounds).
TO-5	DNPH liquid impinger	HPLC	UV	Very volatile	-20 to 56	aldehydes and ketones	1 to 50	2: Uses HPLC	1. Draw ambient air into midget impinger containing 10 ml DNPH reagent	2. Place solution in vial and return to lab. Remove isooctane layer, extract aq.	3. Evaporate organic layers and dissolve residue in methanol.	4. Inject into HPLC.	5. Determine derivatives using UV detector at 370 nm.
TO-11A	DNPH Cartridge	HPLC	UV	Very volatile	-20 to 56	aldehydes and ketones	0.5 to 100	2: Similar to TO-5, but use of cartridge might be more costly	1. Draw ambient air into DNPH coated cartridge. Place cartridge in glass vial and seal.	2. Return to lab. Remove cartridge and wash with acetonitrile.	3. No further processing needed.	4. Acetonitrile solution is diluted and injected into HPLC.	5. Determine derivative by UV detection at 350 nm.
TO-14A	Cannister / cryog. trap	GC	FID/ECD or MS	Medium volatile (covers almost all VOCs)	-29 to 213	non-polar VOCs	0.2 to 25	2: Cannister system req., FID optional	1. Draw ambient air into cannister (e.g. 6L) equipped with flow control device.	2. Return to lab. Dry with Nafion dryer or alternative.	3.Transfer VOCs to cryog loop (trap), then heat trap for insertion of VOCs into GC.	4. Separation in GC for transfer either to MS or to combination-detector system.	5. TO-14A describes either a two-way MS system (SCAN versus SIM) or a three-way FID-PID).
TO-15	Cannister / sorbent trap	GC	MS	Medium volatile (covers almost all VOCs)	-50 to 240	polar/non-polar VOCs	0.2 to 25	3: Cannister plus solid adsorbent with MS	1. Draw ambient air into cannister (e.g. 6L) equipped with flow control device.	2. Return to lab. Pass sample through multisorbent packed tube. Purge water vapor with helium.	3. Cryog. trap concentrator optional.	4. Separation in GC.	5. identify and measure compounds by MS
TO-16	none	FTIR, open path	Infra-red spectrom.	Less volatile (covers med. also)	25 to 500	polar/non-polar VOCs		2: No sampling system req., but complex field equip.	1. No specific sampling system. All of the air in the line of the FTIR is "sampled".	2. none	3. none	4. none	6. Identify and measure compounds in open air by FTIR.
TO-17	Adsorbent tube	GC	MS	Very volatile (covers med. also)	-60 to 200	polar/non-polar VOCs	0.2 to 25	3. Uses multisorbent cartridge and MS	1. Draw ambient air through a multisorbent packed tube.	2. Seal and pack tube. Return to lab. Tube may be stored before analysis.	3. Transfer VOCs to intermediate adsorbent trap or directly to GC, by heating sampling tube.	4. Separation in GC.	5. Identify and measure compounds by MS.

Note 1 Most of the information in this table is from the EPA " Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, 2nd Edition, EPA/625/R-96/010b, January 1999, available at the AMTIC webpage. AMTIC webpage, http://www.epa.gov/ttn/amtic/airtox.html, or from descriptions of the individual Methods, available at the same webpage.

Note 2 Temperature ranges for the methods are found in the Compendium referenced above, Table 2, pages 5-10, or in the descriptions of the Methods, where the temperature range for the Method is inferred from tests for detection of VOCs Boiling Points and CAS numbers are found in "CRC Handbook of Chemistry and Physics," 76th Edition, D. R. Lide, ed., Boca Raton, January 1995, Section 3, pp.3-1ff.

Effective temperature ranges for adsorbents are found in the description for TO-17, Table 1, pp. 17-33 to 17-44

FOR VERY VOLATILE VOCs: (BP < 50)	Choose an adsorbent (multisorbent) with capability of adsorbing in the required BP range. Then choose a TO Method with an adsorbent sampling procedure.
FOR MEDIUM VOLATILE VOCs: (50 < BP < 120)	Choose either a cannister or an adsorbent system which covers the BP range as precisely as possible, so as to avoid the cost of excess capability.
FOR LESS VOLATILE VOCs: (120 < BP)	Choose either a cannister or an adsorbent system of lowest possible cost.

		HIGHLY VOLATILE	MEDIUM VOLTILE	LESS VOLATILE
SAMPLING:	**cannister**	TO-14A(?)	TO-14A	none
	adsorbent	TO-17	TO-2	TO-3
	cann/ads	TO-15 (?)	TO-15	TO-1
DETECTION:	**mass spec**	TO-15, TO-17	TO-2, TO-14A	TO-1
	flame ion.	TO-14A (?)	TO-2, TO-14A	TO-3

(?) = not optimal match of ranges.

Note 3 The assumptions underlying the cost comments are, that in general, cannister sampling is more costly than adsorbent because of the equipment required for field air intake, and that MS is a more costly method than FID because of the higher equipment cost. However, there are always tradeoffs, for example, between equipment cost and personnel training costs. And some sorbent cartridges may well be as costly as the comparable cannister equipment.

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