REQUEST FOR QUOTATION

January 22, 2021

PROJECT: Analysis of Non-Methane Organic Compounds

QUOTES DUE BY: 5:00 PM on Thursday, February 11, 2021

OVERVIEW

The San Joaquin Valley Unified Air Pollution Control District (District) collects ambient air samples that can be analyzed for specific Non-Methane Organic Compounds (NMOC). The air samples are sent to laboratories that will analyze and upload to EPA's Air Quality System (AQS) using AIRS parameter codes. The District has participated in the EPA's Enhanced Photochemical Assessment Monitoring Station (PAMS) monitoring program (PAMS) program for a number of years and will continue to use EPA's list of PAMS Compounds (Attachment B) as the targeted species except for acetaldehyde, acetone, and formaldehyde. The District is requesting all analyses be performed in adherence to the 1998 USEPA PAMS Technical Assistance Document (TAD), USEPA method TO-15, or other methods as appropriate for PAMS analysis in accordance with USEPA's AQS database requirements.

The District is issuing this Request for Quotation (RFQ) in order to retain a qualified contractor who will analyze air samples collected in 2021. The sampling period is June through August 2021.

To be considered for this project, contractors must meet the minimum eligibility requirements and submit cost-effective proposals that satisfy this RFQ's quotation requirements. The District will pay on a per canister basis. Payments will be made after proper verification of completed submission of all samples to EPA's AQS database and District evaluation of EPA Quality Control Reports, confirming that the work was completely and satisfactorily carried out.

Because District funding for the project may include federal funds:

- Contractor shall comply with all federal and state conflict of interest laws, statutes, and regulations, which apply to performance of this Agreement and shall be applicable to all parties and beneficiaries and any officer, agent, or employee of District under this Agreement.

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and beneficiaries under this Agreement and any officer, agent, or employee of District.

- The contractor must not be presently debarred, suspended, proposed for debarment, declared ineligible, voluntarily excluded from participation or otherwise excluded from or ineligible for participation under federal assistance programs. Contractor must ensure that all subcontractors employed for conduct of this project also certify compliance with this provision of law to the contractor.

- A contractor or any individual identified in the proposal that appears in the Excluded Parties List System (EPLS) is not eligible for award of a contract. The EPLS is a central registry that contains information regarding entities debarred, suspended, proposed for debarment, excluded, or otherwise declared ineligible from receiving Federal contracts. Access to the EPLS is available at www.epls.gov.

- The contractor certifies by signing the signature page of the original copy of the submitted proposal and any amendment signature page(s) that the proposer is not presently debarred, suspended, proposed for debarment, declared ineligible, voluntarily excluded from participation, or otherwise excluded from or ineligible for participation under federal assistance programs.

The contractor will provide certification that commercial general liability insurance coverage ($1,000,000 per occurrence) for bodily and personal injuries or for property damage as well as Workers Compensation Insurance as in accordance with the California Labor Code are obtained and are in full force.

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 Thursday, February 11, 2021. Quotations received after this time and date will not be accepted.

2. Email the proposal to Robert Gilles at robert.gilles@valleyair.org then call (559) 230-6000 to confirm receipt.

3. The subject line of the email should read “Quotation for Analysis of Non-Methane Organic Carbons excluding Carbonyls.”

MINIMUM ELIGIBILITY REQUIREMENTS

Contractors must meet the following minimum eligibility requirements:

1. Successful completion of PAMS analyses for a public agency within the last three years.

2. Possess demonstrated ability to create and upload AQS data files within the last three years. Provide copies of appropriate AQS load reports.

3. Completion of Attachment A (Itemized Cost List).

QUOTATION REQUIREMENTS

At a minimum, submitted quotations are to individually address the above three 'Minimum Eligibility Requirements' and numbers 2 through 7 of the below 'Quotation Requirements:'

1. Not exceed 20 pages in length (including cover letter and reference material) and pages must be numbered.

2. Describe previous experience in the documentation and analysis of PAMS cannisters.

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. Generally describe the process that the contractor will use in the analyses of the samples.

5. Describe previous experience with AQS, including uploading data into AQS, and including a report from AQS of data that was uploaded by your respondent from the last three years.

6. Include a price quote on Attachment A (Itemized Cost List) for the analysis of an Audit Sample or Performance Evaluation that the District may request.

7. It is not anticipated that any repairs will be required this year. Please provide an hourly labor rate for repairs.

A contractor who submits a quotation in response to this RFQ is encouraged to demonstrate support for the District's *Green Procurement and Sustainable Practices Policy* through the following:

1. Provide verification of environmentally friendly business practices through green certification programs or equivalent means

2. Participate in eco-friendly programs such as HAL Partners. More information can be found here: http://healthyairliving.com/

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. At any time the District may require that the contractor successfully complete an analysis of an Audit Sample or Performance Evaluation in order for the District to evaluate the performance of the lab.

2. In 2021, there are approximately ***560*** samples sent to the contractor for analysis. Sampling will be conducted during the months of June, July and August of 2021.

3. The contractor shall perform NMOC analysis using the 1998 USEPA PAMS Technical Assistance Document (TAD), EPA method TO-15, or other methods as appropriate for PAMS analysis in accordance with EPA's AQS database requirements, for the list of chemicals found in Attachment B (except for acetaldehyde, acetone, and formaldehyde).

4. The District will supply the Entech two liter (2L) inert ceramic-coated (Silonite™) stainless steel canisters.

5. The District will supply the shipping containers. The contractor will supply the Chain of Custody Forms (COC). The District can provide a COC form at the request of the contractor.

6. Analyzed, cleaned and certified canisters shall be in the District's possession within 11 days of the contractor receiving them. All canisters are to be shipped via UPS ground shipping. If canister shipments need to be expedited, then the contractor is responsible for any additional cost. The contractor will contact and coordinate with the District with regards to shipping locations and addresses (Fresno and Bakersfield). The contractor is responsible for all record keeping regarding the shipping of canisters to the individual District locations, recording the number of canisters being sent to each location, and the shipment's date. 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 parts, etc. The certification tag shall include a check list for these items.

7. The District may ask the contractor make repairs.

8. The contractor is responsible for all recordkeeping and shipping costs of canisters and other materials being sent to the District and/or the audit laboratory for this project. The District is responsible for recordkeeping and shipping costs to return the above mentioned materials (other than canisters) to the contractor.

9. Payment schedule:

    a. Since this is a short term contract, the District prefers invoicing when all the work is completed to the satisfaction of the District. Upon receiving the invoice, the District will compare what was uploaded to AQS with the documentation provided by the contractor and ensure that all of the contract requirements are met. Once everything is verified, the contractor will send a single invoice to the District and payment will be made.

10. The contractor shall retain and archive a copy of all paper and electronic records of this project for a minimum of three 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.

11. The contractor will be available by phone to discuss issues related to this project on 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.

12. It is understood by the Contractor that time is of the essence in the performance of this project.

13. Since this Agreement exceeds ten thousand dollars ($10,000), the contractor will be subject to examination and audit of the auditor general for a period of three years after final payment under contract.

QUALITY CONTROL REQUIREMENTS

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 Reference Gas Cylinder for calibration standard purposes. The gas cylinder must include the compounds

appropriate for compounds listed in Attachment B. These gases must be traceable to a National Institute of Standards and Technology (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. Analyzed, cleaned and certified canisters shall be returned and be in the District's possession within 11 days of the contractor receiving them. All canisters are to be shipped via UPS ground shipping. If canister shipments need to be expedited, then the contractor is responsible for any additional cost.

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 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 a vacuum level between -30 PSI and -20 PSI will be considered acceptable and ready for use. Canisters received with less than -19.9 PSI (truncated) may be returned to the contractor for cleaning and certifying if no leaks or other issues are found. If the canister has a leak the District will work with the contractor or the manufacture to repair the leak. In some instances the District will repair the canister. In addition, the contractor will clean all 200 canisters prior to the start of the sampling period. This is a onetime task since all of the canisters are new.

5. The contractor will analyze and include in the reports one clean and certified canister per day as a part of the quality control certification process. Another report is to include the number of canisters passed and failed with regards to the total number of canisters that went through the 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 in an electronic form (DVD, Flash Drive, Compact Disc, etc.)

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 National Air Toxics Trend Stations (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 upload data to AQS for the compounds in Attachment B as 'Reported Data' except for acetaldehyde, acetone, and formaldehyde. Additional compounds that the District is interested in will be reported directly to the District and not uploaded to AQS. A summary report will need to be created for these compounds.

2. Laboratory equipment must be capable of detecting and measuring levels of VOCs as low as one parts per billion carbon (PPBc) but reporting all detection levels.

3. Reported data is to meet Level IV criteria according to current EPA guidelines.

4. Data is to be reported to the District in both parts per billion carbon (PPBc) and parts per billion volume (PPBv).

5. The data formatted and uploaded to the AQS database is to utilize PPBc.

6. All measured values are to be reported. Any data below the Practical Quantification Limit (PQL) will be reported and flagged with "LJ". All non-detectable data will be reported as zero and flagged with "ND". Other Qualifier Codes can be used if necessary.

7. The contractor will submit monthly e-mails summarizing the analyzed data during the course of the project.

8. The contractor's data files and reports will provide the resulting data on a single CD, DVD, or flash drive:

    a. The CD, DVD, or flash drive shall have a subdirectory dedicated to each site's files labeled with the site's name and AIRSCODE. Each site will have monthly subdirectories containing all of the relevant files for that month as described elsewhere in this RFQ.

    b. EPA Quality Control Reports: 'Load Report', 'Statistical Evaluation and Critical Review Report' and the 'Raw Data Inventory Report' shall be also recorded on the same CD, DVD, or flash drive used above.

    c. This CD, DVD, or flash drive will be sent to the District after all the data is uploaded into AQS.

d. Alternatively, the contents of the CD, DVD, or flash drive may be sent by email in a zip file meeting the requirements in 8.a through 8.c. above.

9. All laboratory activities and completed data file uploaded reports (to include passage of EPA Quality Control Reports) are to be submitted to the District and AQS by **no later than November 30, 2021.**

EVALUATION OF RESPONSES TO THIS RFQ

Each response to this RFQ will be evaluated with particular emphasis on how well the respondent complies with the information requested in this RFQ, experience in PAMS analysis, experience in uploading to EPA's AIRS system, and cost for services as shown on Attachment A. Not providing all of the information requested in this RFQ will lower the overall score and may be grounds to disqualify the response from further review. The District will calculate the cost of postage to and from your laboratory using UPS ground shipping. This postage cost will be included in the evaluation of your proposal.

INQUIRIES

Technical and administrative questions concerning this RFQ should be directed to Robert Gilles, Air Quality Analysis and Research Supervisor, San Joaquin Valley Unified Air Pollution Control District at robert.gilles@valleyair.org or (559) 230-6000. An editable copy of Attachment A (Itemized Cost List) is available on request.

Attachment A

Itemized Cost List

Itemized Cost List for 2021 PAMS NMOC

Show costs on the following table.

Costs	Costs
Cost per analysis of each valid sample.	
Cost per canister for evacuation, cleaning, and certification.	
Cost of audit sample or performance evaluation.	
Cost per canister for file creation and uploading data into AQS.	
Cost of reporting one (1) missing or invalid sample (canisters not eligible for analysis).	

Attachment B

PAMS Compounds

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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