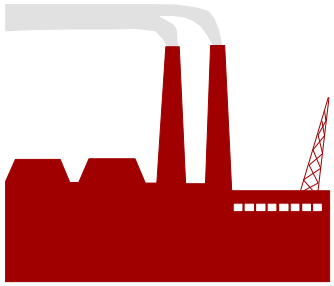
# METHODS 98
# STATUS OF STATIONARY SOURCE METHODS FOR AIR TOXICS



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## COMMENTS AND SUGGESTIONS

The following information is included to give the user of this document perspective on the information contained therein and to aid in decisions regarding its use.

1. The status table contains a summary of the methods type and status for stack sampling and analysis of each of the 189 air toxics listed in the 1990 Clean Air Act Amendments. The table and its attachments have no direct regulatory standing, and therefore do not constitute approval of the use of the methods to satisfy regulatory requirements. Such approval must always be obtained from the regulatory agency or group involved in the individual project. Hopefully this compilation will aid both the regulator and the regulated community in making planning decisions for air toxics source testing.

2. Methods 98 is a May 1998 update and expansion of the 12/14/89 version of the status table, which was originally produced primarily from memory or opinion with the use of only a very few reference texts. An intermediate partial update was produced in 1994, but was not circulated widely. A large amount of field evaluation data has been produced by EPA and its contractors since 1989, and an attempt has been made to utilize all of it in Methods 98. The 1998 status table, therefore, is based much more on field and lab. test information than were its predecessors. No attempt has been made to perform a comprehensive literature survey and to include field test information from sources outside EPA. It is the author's opinion, however, that very little data from outside sources exists that would meet the criteria needed for useful inclusion in this table. The scope of Methods 98 has been expanded in order to give the user easy access to the papers and reports which contain the information behind the Status Table entries, and compilation tables are included which contain much of the field and lab. data. Foot notes for each column on the compilation tables lead the reader to a corresponding item on the Reference List. The reference list contains at least one source, usually a report and a paper, for all of the recently generated data and for some of the older studies. The information in the attached tables and the referenced papers is more compact, and is usually much easier to use than that in the reports. The reports provide much more detail. Some, but not all, of the Status Table entries include suggested references. Other references may be identified by scanning the Reference List for appropriate topics.

3. Methods such as 0010 (MM5), 0030 (VOST sampling), 5041/8260 (VOST analysis), and 8270 (GC/MS) are from the SW-846 Methods Manual used by OSW and the Regions for RCRA related work. Method 5, Method 15,and Method 106 are examples of Federal Register Methods historically related to OAQPS air programs. Some of the methods have been promulgated by both groups under different method numbers. Methods and other useful material can be obtained from sources given later in this document. The SW-846 methods listed are the most recent versions, for example 8270C and 5041A. In the future, later versions of the same method should function just as well, or better. In most cases, data obtained with earlier versions of the same method will also be sound, but new tests should always utilize the most recent rendering of the procedure. Methods such as XHCN and XACN are Office of Research and Development produced methods which have been cleared for publication, but which have not yet been promulgated by one of the program

offices. Copies of the "X" methods are included in the corresponding research reports listed in the references.

4 The sampling methods listed are generally intended for relatively low concentrations of materials in stack gases. Alternate methods may be necessary for process streams or flue gases with no control devices. Not all methods that might be effective are included on the table. The Tedlar bag version of M18 would probably be effective for the same compounds that 0040 sampled well, provided that the source did not emit sorptive particulate matter or condensable water vapor, and that sorption losses in the lines were minimal. The performance of the sorbent tube version of Method 18 would be less easy to predict, and would have little relation to 0040 performance.

5. Priority has been given in this table to methods such as 0010 (a.k.a Modified Method Five, a.k.a. SemiVOST) or Method 29/ Method 0060 (a.k.a. the Multiple Metals Train) which have the most potential for determination of many compounds or metals simultaneously. Alternate single pollutant methods are often given in the comments column. Exclusion of a method from the Status Table does not necessarily imply that it will not perform adequately.

6. Many of the compounds on this list are also on RCRA Appendix 8 but listed under a different name. In cases where common, alternate identities have been identified, these are given in the comments column. No attempt has been made to list all alternate chemical names. In some cases, two inconsistent chemical names or an inconsistent pairing of a name with a CAS number has been given on the CAAA list. Cases such as these have been noted in the Status Table, and the CAS number has been assumed to be the primary reference (*i.e.* the correct CAS number for the compound intended to be regulated). The author has no idea, whatever, what the legal ramifications are of such mistakes in the CAAA.

7. In general the compounds that have identical listings in the sampling column and in the analysis column can be determined simultaneously. Some of the analyses may require more than one GC or HPLC run to accomplish this end.

9. Unless otherwise stated, metals methods produce total Cr, total Pb, etc. Metals oxidation state or compound speciation is always difficult, often impossible, and requires special S&A.

10. Even though much less field data is available for Method 0031 than for Method 0030, the former should always perform at least as well as the latter, and often times better. The limited comparison data generally, but not always, supports this position. The author believes that 0031 can always be successfully substituted for M0030, and usually should be chosen for new projects.

11. The field and lab. recovery tables have not been included for all compounds or all methods on the Status Table, but there should be at least one reference in the Reference List to support each "f" or "l" listing in the table. The "m" and "s" listings are more conjectural, and may or may not have direct support in the references.

12. Only CAAA toxics are included on the Status Table, but data for a few additional compounds may be found on the results tables.

13. Poor performance of one of the basic methods such as M0010 is often a result of reactivity of the target compound. The relatively non-reactive compounds will consistently show good recoveries, the highly reactive compounds will consistently exhibit very poor recoveries, but the marginally reactive compounds may show variability as a function of the reactivity of the stack gas matrix being sampled. Cloroprene, for example, yielded field test results of f2 and f4 along with l1 lab. recoveries. Caprolactam actually showed f1, f4, and l1 results. When sampling compounds with a history of mixed performance, it is probably a good idea to spike the sorbent resin (for sorbent methods) with an isotopically labeled recovery standard before sampling. Carbon or chlorine labels are the least likely to exchange to another compound. Method 23 uses a form of this technique, as does M0040.

14. Laboratory recoveries are not usually shown on the Summary Table unless field results were poor, or the lab. results are at odds with the field results. The code does not indicate how many field results of a given category were obtained, see the compilation tables or the reference documents for that type of information.

15. A number of the CAAA compounds were eliminated from further testing with Methods 0030 and 0010 when they failed initial laboratory studies. This was usually an analytical problem rather than a sampling deficiency. In the major studies which produced the data in the compilation tables, no effort was made to utilize alternate analysis methods. In some cases, potential alternates have been suggested in the Status Table. Method 0010 will collect any organic compound with a boiling point above 100°C. If the compound is not altered by chemical reaction during sampling, field recovery, transport or storage, then identification of a successful quantification scheme becomes a matter of finding effective extraction and determinative analytical methods. The researcher investigating a problem of this nature, should find References 32, 33, 42, 56, 57, and 58 especially helpful.

## STATUS AND RECOVERY TABLE CODE DEFINITIONS

R %Recovery of spiked standard.

C Method 301 bias correction factor

_ An underlined method is not recommended for the listed air toxic.

? Effectiveness of the method for the listed air toxic is questionable or showed mixed results.

f1 Data are available from at least one Method 301 field test where $143\% \geq R \geq 76.9\%$ (equivalent to $0.70 \leq C \leq 1.30$) and the RSD of R was $\leq 50\%$.

f2 Data are available from at least one Method 301 field test where $150\% \geq R \geq 50\%$ (equivalent to $0.67 \leq C \leq 2.00$) and the RSD of R was $\leq 50\%$.

f3 Data are available from at least one field test not fully qualifying as Method 301 where $150\% \geq R \geq 50\%$ (equivalent to $0.67 \leq C \leq 2.00$) and the RSD of R was $\leq 50\%$. Some of the recovery data may be better than the minimum shown, and the test may only have failed to meet minimum replicate criteria for full Method 301 statistical analysis.

f4 Data are available from at least one Method 301 field test where $R \leq 50\%$ or $R \geq 150\%$ or the RSD of R was $\geq 50\%$.

f5 Data are available from at least one field test not fully qualifying as Method 301 where $R \leq 50\%$ or $R \geq 150\%$ or the RSD of R was $\geq 50\%$.

l1 Laboratory test data are available where full scale sampling equipment, dynamic spiking , and a stack simulator were utilized. The RSD of R was $\leq 50\%$, and $143\% \geq R \geq 76.9\%$ (equivalent to $0.70 \leq C \leq 1.30$). This is essentially a successful Method 301 test in the laboratory.

l2 Laboratory test data are available where full scale sampling equipment, dynamic spiking , and a stack simulator were utilized. The RSD of R was $\leq 50\%$, and $150\% \geq R \geq 50\%$ (equivalent to $0.67 \leq C \leq 2.00$).

l3 Laboratory test data are available where full scale sampling equipment, dynamic spiking , and a stack simulator were utilized. $R \leq 50\%$ or $R \geq 150\%$ or the RSD of R was $\geq 50\%$ or unknown.

l4 Other laboratory test data are available, where $143\% \geq R \geq 76.9\%$ (equivalent to $0.70 \leq C \leq 1.30$) and the RSD of $R \leq 50\%$ or unknown. The data from tests in this category may be insufficient to yield a credible RSD.

l5 Other laboratory test data are available, where $150\% \geq R \geq 50\%$ (equivalent to $0.67 \leq C \leq 2.00$) and the RSD of $R \leq 50\%$ or unknown. The data from tests in this category

may be insufficient to yield a credible RSD.

l6 Other laboratory test data are available, where $R \leq 50\%$ or $R \geq 150\%$ or the RSD of R was $\geq 50\%$ or unknown. The data from tests in this category may be insufficient to yield a credible RSD.

l7 Laboratory tests showed no response in VOST analytical system (5041A & 8260B). See References 5, 7, 11, and 16.

l8 Laboratory tests showed weak response in VOST analytical system (5041A & 8260B). See References 5, 7, 11, and 16. Special attention or modification necessary for reliable operation.

s Should work. For sampling methods, no confirmatory field or laboratory data has been identified, but the structure of the compound or its similarity to validated compounds makes the prognosis optimistic.

m Might work. This designation usually implies that the technique given should work if the compound survives the sampling and analysis process, but that we have strong reservations about its ability to do so. This status is usually linked with reactivity/instability. Many compounds are stable enough to analyze, but will not tolerate prolonged exposure to water, $NO_2$, or other materials during sampling.

n No known adequate method. This always means we know of no reliable method for this pollutant. We usually have identified a number of unreliable methods for the pollutant. **If negative data are available, the sampling method will be underlined**.

sp Suspected problems. The suspected problem is given in the comments, and is often related to reactivity.

kp Known problems. This is similar to the suspected problem except that our fears have been confirmed by data. **If data indicate questionable or inconsistent performance, the sampling method will be followed by a question mark.**

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 75-07-0 | Acetaldehyde | 0011 | f1 | 8315A | Simultaneous aldehydes possible. Refs. 23, 40 |
| 60-35-5 | Acetamide | 0010 | m,sp | 8032 | May be reactive |
| 75-05-8 | Acetonitrile | XACN | f1 | 8015B 8033 | See Refs. 24 & 26. |
| 98-86-2 | Acetophenone | 0010<br>0011 | f1<br>f1 | 3542 8270C<br>8315A | See References 23 & 40 for 0011. |
| 53-96-3 | 2-Acetylaminofluorene | 0010? | f2f4l1 | 3542 8270C | |
| 107-02-8 | Acrolein | 0011?<br>PFBHA | f2, kp<br>l4 | 8315A<br>GC/MSorECD | Stability problems, even in DNPH<br>See references 45 & 50 for PFBHA approach. |
| 79-06-1 | Acrylamide | 0010 | m, sp | GC/MS or<br>8316 | Polar, water soluble. Poor GC, needs work. |
| 79-10-7 | Acrylic Acid | 0010<br>sorbent | m,sp<br>l4 | 8316<br>GC/FID | Suspect polymerization may be problem<br>Ref 50&54, prototype needs to be isokinetic. |
| 107-13-1 | Acrylonitrile | XACN<br>0030 0031 | s<br>s l8 | 8015B 8033<br>5041A 8260B | See Refs. 24 & 26.<br>Purges poorly, needs special attention. |
| 107-05-1 | Allyl Chloride | 0030 kp<br>0031 kp<br>0040 | f4 l1<br>f4<br>f1 | 5041A 8260B<br>5041A 8260B<br>8260B | 0030 recoveries good in lab., 30% from field test (suspect reactivity) |
| 92-67-1 | 4-Aminobiphenyl | 0010<br>acid liquid | m, sp<br>s | GC/MS<br>HPLC/PDA | Ref 50&51. |
| 62-53-3 | Aniline | 0010? kp<br>acid liquid | f2f4l2<br>l4 | 3542 8270C<br>HPLC/PDA | Extraction and reactivity problems.<br>Ref 50&51, prototype needs to be isokinetic. |
| 90-04-0 | o-Anisidine | 0010 kp<br>acid liquid | f4 l2<br>s | 3542 8270C<br>HPLC/PDA | Ref 50&51, prototype needs to be isokinetic. |
| 1332-21-4 | Asbestos | - | - | microscopy | Separate S&A |
| 71-43-2 | Benzene | 0030<br>0040 | f1<br>f1 | 5041A 8260B<br>8260B | Make sure that the Tenax is clean. |
| 92-87-5 | Benzidine | 0010? kp<br>acid liquid | f2f4l3<br>s | 3542 8270C<br>HPLC/PDA | May react during sampling.<br>Ref 50&51, prototype needs to be isokinetic. |
| 98-07-7 | Benzotrichloride | 0010 | f2 | 3542 8270C | |
| 100-44-7 | Benzyl Chloride | 0010 | f1 f2 | 3542 8270C | |
| 92-52-4 | Biphenyl | 0010 | f1 | 3542 8270C | |
| 117-81-7 | Bis(2-ethylhexyl)phthalate | 0010 | f2f4l1 | 3542 8270C | a.k.a. DEHP |
| 542-88-1 | Bis(chloromethyl)ether | n, kp 0010<br>kp 0030 | f4 l1<br>l7 | 3542 8270C | Reacts quickly with water |
| 75-25-2 | Bromoform | 0010 | f1 f2 | 3542 8270C | |
| 106-99-0 | 1,3-Butadiene | 0040? kp | f4 | 8260B | Reactive, borderline results. |
| 156-62-7 | Calcium cyanamide | 0010<br>M5 | s | ? | Should be able to collect salt as particulate.<br>Analysis is problematic, low solubility without decomposition. |
| 105-60-2 | Caprolactam | 0010? | f1f4l1 | 3542 8270C | Mixed results, suspect hydrolysis. |
| 133-06-2 | Captan | 0010 | m | 3542 8270C<br>HPLC | Can be reactive. |
| 63-25-2 | Carbaryl | 0010? | f1f4l1 | 3542 8270C | Mixed results. |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 75-15-0 | Carbon Disulfide | 0030? | f2f4l2 | 5041A 8260B | Mixed results. |
| 463-58-1 | Carbon Tetrachloride | 0030/0031 | f1 | 5041A 8260B | |
| 463-58-1 | Carbonyl Sulfide | M15<br>0040 | s | GC/FPD<br>CG/FPD | |
| 120-80-9 | Catechol | 0010 | m | 3542 8270C | Careful pH control during extraction mandatory. Recovery may be difficult. |
| 133-90-4 | Chloramben | acid liquid | l4 | HPLC/PDA | Ref 50&51, prototype needs to be isokinetic |
| 57-74-9 | Chlordane | 0010 | f1 | 3542 8270C | |
| 7782-50-5 | Chlorine | M26/26A<br>0050 0051 | f1 | 9056 9057 | Halogens & halo-acids can be done simultaneously |
| 79-11-8 | Chloroacetic Acid | n, sp | n | HPLC | |
| 532-27-4 | 2-Chloroacetophenone | 0010 | f1 f2 | 3542 8270C | |
| 108-90-7 | Chlorobenzene | 0010<br>0030?<br>0031? | f1 f2<br>f1<br>f1 | 3542 8270C<br>5041A 8260B<br>5041B 8260B | Above recommended bp limit for 0030/0031, and for 0040. |
| 510-15-6 | Chlorobenzilate | 0010 | f1f3f4 | 3542 8270C | |
| 67-66-3 | Chloroform | 0030<br>0031<br>0040 | f1<br>f1<br>s | 5041A 8260B<br>5041A 8260B<br>8260B | |
| 107-30-2 | Chloromethyl Methyl Ether | n kp 0030 | l7 | 5041A 8260B | May decompose during s&a |
| 126-99-8 | Chloroprene | 0030?<br>0031 | f2f4l1<br>f1 | 5041A 8260B<br>5041A 8260B | Recoveries good in lab., mixed in field. Suspect reactivity. |
| 1319-77-3 | Cresols/Cresylic Acid | - | - | - | Determine as individual cresols by methods following. |
| 95-48-7 | o-Cresol | 0010<br>NaOH | f1 f2<br>f1 | 3542 8270C<br>HPLC | NaOH impinger collection for emissions in the 20-100 ppm range. Refs. 46, 64, & 65. |
| 108-39-4 | m-Cresol | 0010<br>NaOH | f2<br>f1 | 3542 8270C<br>HPLC | NaOH impinger collection for emissions in the 20-100 ppm range. Refs. 46, 64, & 65. |
| 106-44-5 | p-Cresol | 0010<br>NaOH | f2<br>f1 | 3542 8270C<br>HPLC | NaOH impinger collection for emissions in the 20-100 ppm range. Refs. 46, 64, & 65. |
| 98-82-8 | Cumene | 0010 | f1 | 3542 8270C | |
| 94-75-7 | 2,4-d | 0010 | s | 8151A, 8321A | |
| 3547-04-4 | DDE | 0010 | f1 | 3542 8270C | CAS #3547-04-4 is on CAAA, The large volume pesticide is 72-55-9. The two are similar (almost congeners) and should behave comparably. |
| 334-88-3 | Diazomethane | n, kp | - | - | Very reactive. Derivative method should be developed. |
| 132-64-9 | Dibenzofurans | 0010 | f1 | 3542 8270C | For PCDF, use Method 0023A or Method 23 |
| 84-74-2 | 1,2-Dibromo-3-Chloro-propane | 0010 | f1 f4 | 3542 8270C | |
| 84-74-2 | Dibutylphthalate | 0010 | f1 f4 | 3542 8270C | Common contaminant |
| 106-46-7 | 1,4-Dichlorobenzene(p) | 0010 | f1 f2 | 3542 8270C | |
| 91-94-1 | 3,3-Dichlorobenzidene | 0010<br>acid liquid | f4 f5<br>s | 3542 8270C<br>HPLC/PDA | Reactive, no good with 0010.<br>Ref 50&51, prototype needs to be isokinetic. |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 111-44-4 | Dichloroethyl Ether | 0010 | f1 f2 | 3542 8270C | Same as bis(2-chloroethyl)ether |
| 542-75-6 | 1,3-Dichloropropene | 0030/0031<br>0010 | f1 f2<br>f1 f2 | 5041A 8260B<br>3542 8270C | Mixed results. May be source sensitive. |
| 62-73-7 | Dichlorvos | 0010 | f1 f2 | 3542 8270C | |
| 111-42-2 | Diethanolamine | n, kp<br>acid liquid | -<br>s | 8270<br>HPLC should | The method of Ref. 50&51 should collect OK if made isokinetic. No benzene ring, so alternate detector may be needed |
| 91-66-7 | N,N-Diethyl aniline | 0010<br>acid liquid | f1 f2<br>s | 3542 8270C<br>HPLC/PDA | Compound confused with Dimethylaniline on CAAA, wrong CAS number listed. Ref. 50&51, prototype needs to be isokinetic. |
| 64-67-5 | Diethyl Sulfate | n, kp | - | - | Probably special S&A. a.k.a. sulfuric acid, diethyl ester |
| 119-90-4 | 3-3-Dimethoxybenzidine | kp 0010<br>acid liquid | f4l3<br>s | 3542 8270C<br>HPLC/PDA | Likely reactive.<br>Ref 50&51, prototype needs to be isokinetic. |
| 60-11-7 | Dimethyl Aminoazobenzene | 0010?<br>acid liquid | f4 l1<br>s | 3542 8270C<br>HPLC/PDA | Suspect reactivity.<br>Ref 50&51, prototype needs to be isokinetic. |
| 121-69-7 | N,N-dimethylaniline | 0010<br>acid liquid | f2 l1<br>l4 | 3542 8270C<br>HPLC/PDA | Incorrectly called diethylaniline on CAAA<br>Ref 50&51, prototype needs to be isokinetic |
| 119-93-7 | 3,3-Dimethyl Benzidine | 0010? kp<br>acid liquid | f1f4l3<br>l4 | 3542 8270C<br>HPLC/PDA | Mixed results probably due to reactivity.<br>Ref 50&51, prototype needs to be isokinetic |
| 79-44-7 | Dimethyl Carbamoyl Chloride | 0010 | m, sp | 8321A | |
| 68-12-2 | Dimethyl Formamide | 0010 | m, sp | 8260B, 8141A | |
| 57-14-7 | 1,1-Dimethyl Hydrazine | 0030? | kp l7 | | Stability problems. Probably needs derivatization method. |
| 131-11-3 | Dimethyl Phthalate | 0010 | f1 | 3542 8270C | Common contaminant |
| 77-78-1 | Dimethyl Sulfate | special | s | special | |
| 534-52-1 | 4,6-Dinitro-o-Cresol, and salts | 0010 | f1f2l3 | 3542 8270C | Bad lab results are puzzling. This test was for the cresol only, not salts. |
| 51-28-5 | 2,4-Dinitrophenol | 0010? | f1f4l3 | 3542 8270C | Mixed results, very good to very bad. |
| 121-14-2 | 2,4-Dinitrotoluene | 0010 | f1 | 3542 8270C | |
| 123-39-11 | 1,4-Dioxane | 0010<br>0030 | f1<br>l7 | 3542 8270C | a.k.a. 1,4-Diethyleneoxide. Easily lost during extraction and concentration. Labeled lab. recovery standard is mandatory. |
| 122-66-7 | 1,2-Diphenylhydrazine | 0010<br>acid liquid | m<br>s | GC/MS<br>HPLC/PDA | Reactive.<br>Ref 50&51, prototype needs to be isokinetic. |
| 106-89-8 | Epichlorohydrin | 0010 kp<br>0030 kp | f2f4l3<br>l7 | 3542 8270C | Mostly poor with 0010, worse with 0030. New method needed. |
| 106-88-7 | 1,2-Epoxybutane | 0030 | m,sp | 5040,(GCMS) | Suspect reactivity problems |
| 140-88-5 | Ethyl Acrylate | kp 0030?<br>0010<br>sorbent | l8<br>m,sp<br>l4 | <br>GC/MS<br>GC/FID | Polymerizes easily<br><br>Ref 50&54. |
| 100-41-4 | Ethyl Benzene | 0010 | f1 | 3542 8270C | |
| 51-79-6 | Ethyl Carbamate | 0010? | f1f4l2 | 3542 8270C | a.k.a. urethane |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 75-00-3 | Ethyl Chloride (Chloroethane) | 0030?kp<br>0031?kp | f2f4l1<br>f4 | 5041A 8260B<br>5041A 8260B | Low bp, 0031 should have done better. |
| 106-93-4 | Ethylene Dibromide | 0010<br>0030?<br>0031? | f1 f2<br>f1f4l1<br>f1 | 3542 8270C<br>5041A 8260B<br>5041A 8260B | a.k.a. dibromoethane. Above recommended bp for 0030/0031. |
| 107-06-2 | Ethylene Dichloride | 0030<br>0031 | f1 f2<br>f1 | 5041A 8260B<br>5041A 8260B | a.k.a. 1,2 dichloroethane |
| 107-21-1 | Ethylene Glycol | 0010 | s | 8015B, 8430 | |
| 151-56-4 | Ethylene Imine (Aziridine) | n kp 0030 | l7 | | Water soluble & polymerizes |
| 75-21-8 | Ethylene Oxide | tedlar bag<br>CARB 431 | f3 | GC/MS<br>GC/FID | Reactivity can cause problems in some matrices |
| 96-45-7 | Ethylene Thiourea | 0010 | m | HPLC/UV<br>8325 | Reactive and water soluble. See Ref. 56 & 57 for HPLC/UV. |
| 75-34-3 | 1,1 dichloroethane (misnamed Ethylidene Dichloride on CAAA) | 0030<br>0031<br>0040 | f1 f2<br>f1<br>f1 | 5041A 8260B<br>5041A 8260B<br>8260B | 75-34-3 is really 1,1 dichloroethane. Ethylidene dichloride is 75-35-4 |
| 50-00-0 | Formaldehyde | 0011 | f1 | 8315A | Simultaneous aldehydes possible, ref. 23&40 |
| 76-44-8 | Heptachlor | 0010 | f1f4l1 | 3542 8270C | |
| 118-74-1 | Hexachlorobenzene | 0010 | f1 f2 f4 | 3542 8270C | Recovery increased greatly with each field test. Last one was 82.6% |
| 87-68-3 | Hexachlorobutadiene | 0010 | f1 f2 | 3542 8270C | |
| 77-47-4 | Hexachlorocyclopentadiene | 0010 | f2 f4 | 3542 8270C | Good to mediocre field tests, poor in the lab. |
| 67-72-1 | Hexachloroethane | 0010 | f1 | 3542 8270C | |
| 822-06-0 | Hexamethylene-1,6-diisocyanate | M207-1 | f1 | M207-2 | Reactive, a.k.a. 1,6 diisocyanatohexane a.k.a. HDI |
| 680-31-9 | Hexamethylphosphoramide | 0010 | f4 l3 | 3542 8270C | Suspect reactivity |
| 110-54-3 | Hexane | 0030<br>0040 | f1<br>f1 | 5041A 8260B<br>8260B | |
| 302-01-2 | Hydrazine | 0010 | kp | GC/MS | Water soluble & unstable, probably requires special S&A |
| 7647-01-0 | Hydrochloric Acid | M26/26A<br>0050 0051 | f1 | 9056 9057 | Halogens & halo-acids can be done simultaneously |
| 7664-39-3 | Hydrogen Fluoride | M26/26A | l4 | 9057 | Methods 13A,13B,14 for total fluoride |
| 123-31-9 | Hydroquinone | 0010 | m,sp | GC/MS | Reactive, solubility problems. |
| 78-59-1 | Isophorone | 0010<br>0011 | f1<br>f1 | 3542 8270C<br>8315A | |
| 58-89-9 | Lindane (all isomers) | 0010 | f1 | 3542 8270C | a.k.a. hexachlorocyclohexane |
| 108-31-6 | Maleic Anhydride | 0010 | s,kp | HPLC | Reacts with water, must quantitate the acid & report as parent compound |
| 67-56-1 | Methanol | 0030?<br>M308<br>MST | m,sp<br>f1<br>f1 | 5041A 8260B<br>GC/FID<br>GC/FID | Highly water soluble, may purge poorly<br>See References 59, 60, & 61 for evaluation of M308 and MST. |
| 72-43-5 | Methoxychlor | 0010 | f2 | 3542 8270C | |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 74-83-9 | Methyl Bromide | 0030?kp<br>0031?kp<br>0040?kp | f2<br>f4<br>f4 | 5041A 8260B<br>5041A 8260B<br>8260B | a.k.a. bromomethane. 0030 barely met f2, 0031 should be better, but was worse. Low bp. 0040 results high. |
| 74-87-3 | Methyl Chloride (Chloromethane) | 0030 kp<br>0031 kp<br>0040 | f4<br>f4<br>f1 | 5041A 8260B<br>5041B 8260B<br>8260B | Artifact problems with Tenax. |
| 71-55-6 | Methyl Chloroform | 0030/0031<br>0040 | f1<br>f1 | 5041A 8260B<br>8260B | a.k.a. 1,1,1-trichloroethane |
| 78-93-3 | Methyl Ethyl Ketone (2-Butanone) | 0011<br>0030?<br>PFHBA | f4<br>l8<br>l4 | 8315A<br>5041A 8260B<br>GC/MSorECD | Water solubility causes problems with 5041A purge. See References 45 & 50 for PFBHA approach. |
| 60-34-4 | Methyl Hydrazine | 0030 | kp | 5040 | Reactive, probably requires special S&A |
| 74-88-4 | Methyl iodide | 0030/0031 | f1 | 5041A 8260B | a.k.a. Iodomethane |
| 108-10-1 | Methyl Isobutyl Ketone (Hexone) | 0010<br>0011<br>PFBHA<br>kp 0030? | f1<br>f4<br>l4<br>l8 | 3542 8270C<br>8315A<br>GC/MSorECD | See references 45 & 50 for PFBHA approach, 23 & 40 for DNPH (0011). |
| 624-83-9 | Methyl Isocyanate | M 207-1 | f1 | M207-2 | a.k.a. isocyanic acid, methyl ester, a.k.a. MI. See Ref. 18. |
| 80-61-6 | Methyl Methacrylate | 0010<br>kp 0030?<br>sorbent | m,sp<br>l8<br>l4 | 5040,(GC/MS)<br><br>GC/FID | May polymerize<br><br>Ref 50&54. |
| 1634-04-4 | Methyl Tert Butyl Ether | kp 0030? | l8 | | a.k.a. tert. butyl methyl ether |
| 101-14-4 | 4,4-Methylene Bis(2-chloroaniline) | 0010<br>acid liquid | m,sp<br>s | GC/MS<br>HPLC/PDA | Suspect reactivity problems during sampling.<br>Ref 50&51, prototype needs to be isokinetic. |
| 75-09-2 | Methylene Chloride (dichloromethane) | 0030/0031<br>0040 | f1<br>f1 | 5041A 8260B<br>8260B | a.k.a. dichloromethane |
| 101-68-8 | Methylene Diphenyl Diisocyanate | M207-1 | f1 | M207-2 | Reactive, See Ref. 18. a.k.a. MDI,a.k.a. 4,4'-Bis(carbonylamino)diphenylmethane. |
| 101-77-9 | 4,4-Methylenedianiline | 0010<br>acid liquid | m, sp<br>s | GC/MS<br>HPLC/PDA | Reactive?<br>Ref 50&51, prototype needs to be isokinetic. |
| 91-20-3 | Naphthalene | 0010 | f1 | 3542 8270C | |
| 98-95-3 | Nitrobenzene | 0010 | f1 | 3542 8270C | |
| 92-93-3 | 4-Nitrobiphenyl | 0010 | f1 | 3542 8270C | |
| 100-02-7 | 4-Nitrophenol | 0010 | f1f2l3 | 3542 8270C | Bad lab results are puzzling. |
| 79-46-9 | 2-Nitropropane | 0010,0030 | s | GC/MS | |
| 684-93-5 | N-Nitroso-N-Methylurea | 0010 | m,sp | HPLC | Unstable |
| 62-75-9 | N-Nitrosodimethylamine | 0010 | f1 | 3542 8270C | |
| 59-89-2 | N-Nitrosomorpholine | 0010 | f1 | 3542 8270C | |
| 56-38-2 | Parathion | 0010 | f1 f2 | 3542 8270C | |
| 82-68-8 | Pentachloronitrobenzene | 0010 | f1f3f4 | GC/MS | |
| 87-86-5 | Pentachlorophenol | 0010 | f1f3f4 | 3542 8270C | |
| 108-95-2 | Phenol | 0010<br>NaOH | f1 f2<br>f1 | 3542 8270C<br>HPLC | NaOH impinger collection for emissions in the 20-100 ppm range. Refs. 46, 64, & 65. |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 106-50-3 | p-Phenylenediamine | 0010<br>acid liquid | m,sp<br>s | GC/MS<br>HPLC/PDA | Reactive, polar, water soluble.<br>Ref 50&51, prototype needs to be isokinetic. |
| 75-44-5 | Phosgene | XPHS | l1 | GC/MS | Reactive, must be derivatized as collected. See Refs. 52 & 53. |
| 7803-51-2 | Phosphine | M29 0060 | s | 6010 6020<br>7000 | Yields total P value |
| 7723-14-0 | Phosphorus | M29 0060 | s | 6010 6020<br>7000 | Yelds total P value |
| 85-44-9 | Phthalic anhydride | 0010<br>0010 kp | s<br>f4 l3 | HPLC<br>3542 8270C | Reacts with water, must quantitate the acid & report as parent compound |
| 1336-36-3 | Polychlorinated Biphenyls (Aroclors) | 0010<br>CARB 428 | s | 3542 GC/MS<br>CARB 428 | Combustion destroys Aroclor patterns.<br>Determine isomer groups or individuals. |
| 1120-71-4 | 1,3-Propane Sultone | 0010 | m | GC/MS | Polar and reactive. |
| 57-57-8 | Beta-Propiolactone | 0010 | m,sp | GC/MS | May be too reactive |
| 123-38-6 | Propionaldehyde | 0011 | f1 | 8315A | Simultaneous aldehydes possible. Ref.23&40 |
| 114-26-1 | Propoxur | 0010 | f1f2 | 3542 8270C | a.k.a. Baygon |
| 78-87-5 | Propylene Dichloride | 0030<br>0031 | f1 f2<br>f1 | 5041A 8260B<br>5041A 8260B | a.k.a. 1,2 dichloropropane |
| 75-56-9 | Propylene Oxide | kp 0030<br>0040 | l7<br>m, sp | | Reactive, water soluble, a.k.a. 1,2 propylene oxide |
| 75-55-8 | 1,2-Propylenimine | n kp 0030 | l7 | | May be reactive |
| 91-25-5 | Quinoline | 0010<br>acid liquid | f1<br>l4 | 3542 8270C<br>HPLC/PDA | Ref 50&51, prototype needs to be isokinetic |
| 106-51-4 | Quinone | 0010<br>0011? | f4l3kp<br>f2,kp | 3542 8270C<br>8315A | May be reactive,a.k.a. 1,4-benzoquinone,a.k.a. p-benzoquinone |
| 100-42-5 | Styrene | 0010? | f1f4l1 | 3542 8270C | Low f4 results puzzling. Reactivity? |
| 96-09-3 | Styrene Oxide | 0010 kp | f4 l3 | 3542 8270C | Reactive. a.k.a. 1,2 epoxyethylbenzene |
| 1746-01-6 | 2,3,7,8-Tetrachlorodibenzo-p-Dioxin | M23<br>0023A | f1 | M23<br>8290 | Special care needed during recovery and analysis. |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 0010 | f1 | 3542 8270C | |
| 127-18-4 | Tetrachloroethylene | 0010<br>0030/0031 | f2<br>f1 f2 | 3542 8270C<br>5041A 8260B | a.k.a. tetrachloroethene,.a.k.a perchloroethylene |
| 7550-45-0 | Titanium Tetrachloride | M29 0060 | s | 6010 6020<br>7000 | For total titanium |
| 108-88-3 | Toluene | 0010<br>0030<br>0040 | fi f2<br>f1<br>f1 | 3542 8270C<br>5041A 8260B<br>8260B | |
| 95-80-7 | 2,4-Toluene Diamine | 0010<br>acid liquid | m,sp<br>l4 | GC/MS<br>HPLC/PDA | Reactive<br>Ref 50&51, prototype needs to be isokinetic. |
| 584-84-9 | 2,4-Toluene Diisocyanate | M207-1 | f1 | M207-2 | Reacts with water,a.k.a. TDI |
| 95-53-4 | o-Toluidine | 0010?<br>acid liquid | f2f4l1<br>l4 | 3542 8270C<br>HPLC/PDA | Mixed results, may be reactive.<br>Ref 50&51, prototype needs to be isokinetic. |
| 8001-35-2 | Toxaphene (Chlorinated Camphene) | 0010 | s | GC/MS,8250 | |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| 120-82-1 | 1,2,4-Trichlorobenzene | 0010 | f1 f2 | 3542 8270C | |
| 79-00-5 | 1,1,2-Trichloroethane | 0010<br>0030/0031<br>0040 | f1 f2<br>f1<br>f1 | 3542 8270C<br>5041A 8260B<br>8260B | |
| 79-01-6 | Trichloroethylene | 0030/0031 | f1 | 5041A 8260B | a.k.a. trichloroethene |
| 95-95-4 | 2,4,5-Trichlorophenol | 0010 | f1 | 3542 8270C | |
| 88-06-2 | 2,4,6-Trichlorophenol | 0010 | f1 f2 | 3542 8270C | |
| 121-44-8 | Triethylamine | n kp 0030<br>acid liquid | l7<br>s | HPLC should | a.k.a. N,N-diethylethanimine. Suspect reactivity. The method of Ref. 50&51 should collect OK. No benzene ring, so alternate detector may be needed |
| 1582-09-8 | Trifluralin | 0010<br>acid liquid | f4l2kp<br>m, kp | 3542 8270C<br>HPLC/PDA | Suspect reactivity, a.k.a. Treflan<br>Ref 50&51, prototype needs to be isokinetic. Analysis method needs modification. |
| 540-84-1 | 2,2,4-Trimethylpentane | 0030<br>0040 | f2<br>f1 | 5041A 8260B<br>8260B | a.k.a. isooctane |
| 108-05-4 | Vinyl Acetate | kp 0030?<br>sorbent | l8<br>l4 | GC/FID | Ref 50&54. |
| 593-60-2 | Vinyl Bromide | 0030?kp<br>0031?kp<br>0040<br>M106 | f2f4l1<br>f4<br>f1 | 5041A 8260B<br>5041A 8260B<br>8260B<br>GC/MS | |
| 75-01-4 | Vinyl Chloride | 0030 kp<br>0031? kp<br>0040<br>M106 | f1f4l1<br>f4 l1<br>f1<br>l5 | 5041A 8260B<br>5041A 8260B<br>8260B<br>GC/MS | Mixed results, 0030 is questionable. Poor field results for 0031 are puzzling, may be due to reactivity. |
| 75-35-4 | Vinylidene Chloride | 0030/0031<br>0040<br>M106 | f1/f1<br>f1<br>l5 | 5041A 8260B<br>8260B<br>GC/MS | a.k.a. 1,1 dichloroethene.<br>a.k.a. 1,1 dichloroethylene |
| 1330-20-7 | Xylenes(mixture) | 0010 | f1 | 3542 8270C | Determine individual xylenes, not total. |
| 95-47-6 | o-Xylene | 0010 | f1 | 3542 8270C | |
| 108-38-3 | m-Xylene | 0010 | f1 | 3542 8270C | |
| 106-42-3 | p-Xylene | 0010 | f1 | 3542 8270C | |
| - | Antimony Compounds | M29 0060 | f1 | 6010 6020<br>7000 | |
| - | Arsenic Compounds | M29 0060 | f1 | 6010 6020<br>7000 | Also Method 108 & 108A |
| - | Beryllium Compounds | M29 0060 | f1 | 6010 6020<br>7000 | Also Method 103 & 104 |
| - | Cadmium Compounds | M29 0060 | f1 | 6010 6020<br>7000 | |
| - | Chromium Compounds | M29 0060 | f1 | 6010 6020<br>7000 | M29 or 0060 for total chromium, 0061 for hexavalent Cr. |
| - | Cobalt Compounds | M29 0060 | s | 6010 6020<br>7000 | |
| - | Coke Oven Emissions | Method<br>109 | - | - | |

| CAS No. | Chemical Name | Sampling Method | S. Code | Analysis Method | Comments |
|---|---|---|---|---|---|
| - | Cyanide Compounds | XHCN | l1 | XHCN | XHCN for HCN, CARB426 for total cyanide. |
| - | Glycol Ethers | n<br>0010 | -<br>s | -<br>8430, 8015B | Category too general, however a method is possible for individual compounds. Should be isokinetic, probably 0010. |
| - | Lead Compounds | M29 0060 | f1 | 6010 6020<br>7000 | Also Method 12 |
| - | Manganese Compounds | M29 0060 | f1 | 6010 6020<br>7000 | |
| - | Mercury Compounds | M29 0060 | f1 | 7470 | Also Methods 101,101A,102. For speciation research see references 50 & 55. |
| - | Mineral Fibers | | | | |
| - | Nickel Compounds | M29 0060 | f1 | 6010 6020<br>7000 | |
| - | Polycyclic Organic Matter | 0010<br>CARB 429 | f3 | 3542 8270C<br>CARB 429 | Individual compounds are determined, not total POM, more or less synonymous with pna, pah, pac. |
| - | Radionuclides (including radon) | M111<br>M114<br>M115 | | | |
| - | Selenium Compounds | M29 0060 | f1 | 6010 7000 | |

Results for Method 0010 halogenated compounds laboratory study and five field tests.

| Compound | First Field Test[a] | | Second Field Test[b] | | Third Field Test[c] | | Laboratory Test[d] | | Margeson, *et al.* Two Field Tests[e] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| bis(chloromethyl)ether | 0.0 | 0.0 | 0.0 | 0.0 | 36.4 | 44.9 | 80.7 | 23.2 | | |
| Epichlorohydrin | 6.0 | 128.1 | 13.4 | 44.2 | 58.5 | 39.7 | 187.0 | 11.7 | | |
| cis-1,3-Dichloropropene | 49.1 | 37.5 | 50.3 | 48.3 | 73.8 | 25.1 | 51.9 | 12.9 | | |
| trans-1,3-Dichloropropene | 52.0 | 35.2 | 79.8 | 63.4 | 79.4 | 21.9 | 29.3 | 13.1 | | |
| 1,1,2-Trichloroethane | 56.4 | 37.7 | 60.3 | 38.2 | 79.8 | 17.6 | 84.4 | 13.5 | | |
| 1,2-Dibromoethane | 58.9 | 36.9 | 62.5 | 40.4 | 85.3 | 19.4 | 83.9 | 12.7 | | |
| Tetrachloroethene | 53.2 | 37.2 | 49.4 | 52.5 | 73.8 | 30.7 | 78.7 | 17.6 | | |
| Chlorobenzene | 62.3 | 43.2 | 65.1 | 40.7 | 76.4 | 18.2 | 86.2 | 11.9 | 86/86 | 22/14 |
| Bromoform | 59.8 | 37.6 | 69.3 | 35.7 | 87.0 | 17.3 | 123.0 | 14.2 | | |
| 1,1,2,2-Tetrachloroethane | 64.0 | 35.3 | 73.9 | 34.5 | 81.7 | 18.5 | 79.7 | 10.5 | 81.5 | 32.9 |
| Dichloroethyl ether | 60.9 | 34.7 | 77.0 | 34.3 | 80.3 | 17.4 | 82.5 | 10.5 | | |
| 1,4-Dichlorobenzene | 56.2 | 35.2 | 73.5 | 35.7 | 84.2 | 15.9 | 78.7 | 12.5 | | |
| Benzyl chloride | 67.4 | 33.4 | 73.9 | 34.9 | 82.1 | 20.9 | 77.9 | 11.7 | | |
| Hexachloroethane | 74.0 | 36.9 | 70.9 | 35.6 | 83.6 | 15.5 | 84.6 | 13.3 | | |
| 1,2-Dibromo-3-chloropropane | 44.8 | 36.0 | 73.8 | 35.7 | 84.3 | 16.8 | 69.8 | 11.4 | | |
| 1,2,4-Trichlorobenzene | 59.5 | 35.7 | 76.1 | 34.5 | 86.8 | 14.2 | 67.7 | 13.3 | | |
| Hexachlorobutadiene | 65.4 | 43.1 | 77.1 | 34.3 | 84.7 | 16.6 | 68.1 | 14.0 | | |
| Benzotrichloride | 60.1 | 36.5 | 72.4 | 38.0 | 75.2 | 20.5 | 85.7 | 16.8 | | |
| 2-Chloroacetophenone | 56.0 | 40.7 | 79.5 | 32.7 | 66.1 | 44.6 | 89.1 | 11.7 | | |
| Hexachlorocyclopentadiene | 42.3 | 61.8 | 59.6 | 37.7 | 68.5 | 35.1 | 975.5 | 24.8 | | |
| 2,4,6-Trichlorophenol | 49.8 | 47.0 | 75.4 | 35.2 | 77.1 | 15.8 | 72.8 | 26.2 | | |
| 2,4,5-Trichlorophenol | 62.7 | 35.3 | 76.6 | 34.5 | 80.7 | 16.1 | 76.1 | 23.8 | | |
| Hexachlorobenzene | 44.6 | 33.9 | 56.5 | 31.0 | 82.6 | 12.7 | 73.3 | 10.0 | | |
| Pentachlorophenol | 42.4 | 41.5 | 60.3 | 25.6 | 64.3 | 49.2 | 57.5 | 60.3 | 124 | 46.3 |
| Pentachloronitrobenzene | 43.4 | 37.9 | 58.5 | 28.9 | 87.5 | 15.8 | 79.2 | 10.1 | | |
| Chlorobenzilate | 40.7 | 50.6 | 61.8 | 33.1 | 78.0 | 17.0 | 131.6 | 32.0 | | |
| 3,3'-Dichlorobenzidine | 4.4 | 164.9 | 0.6 | 264.6 | 10.0 | 78.8 | 1352.4 | 43.4 | | |

a - Mean of 12 replicate quad train runs. Coal fired power plant. From references 8 & 9.
b - Mean of 4 replicate quad train runs. Organic chemical manufacturing facility. From references 9, 10 & 30.
c - Mean of 10 replicate quad train runs. Organic agricultural chemical manufacturing facility. From references 10 & 17.
d - Mean of 7 replicate quad train runs. Full scale sampling train, dynamic spike, stack simulator. From reference 9.
e - Mean of 13-39 replicate quad train runs, with dynamic spiking. Two hazardous waste incinerators. From reference 4.

Results for Method 0010 nonhalogenated organic compounds, laboratory study and four field tests.

| Compound | First Field Test[a] | | Second Field Test[b] | | Laboratory Test[c] | | Margeson, *et al.* Two Field Tests[d] | |
|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| di-n-butyl phthalate | 46 | 54 | 107 | 14 | 118 | 10 | | |
| bis(2-ethylhexyl) phthalate | 48 | 23 | 65 | 93 | 110 | 32 | | |
| m-/p-cresol | 69 | 14 | 65 | 49 | 105 | 5 | | |
| dimethyl phthalate | 82 | 17 | 123 | 7 | 105 | 9 | | |
| phenol | 89 | 9 | 56 | 22 | 96 | 7 | 96 | 14 |
| o-cresol | 90 | 15 | 71 | 34 | 100 | 5 | | |
| 2,4-dinitrophenol | 111 | 31 | 24 | 87 | 5 | 155 | | |
| 4-nitrophenol | 114 | 31 | 59 | 18 | 38 | 33 | | |
| 4,6-dinitro-o-cresol | 122 | 14 | 53 | 34 | 44 | 44 | | |
| quinone | 2 | 438 | not tested | | 28 | 97 | | |
| hexamethylphosphoramide | 14 | 118 | not tested | | 49 | 74 | | |
| trifluralin | 27 | 41 | not tested | | 149 | 11 | | |
| dimethylaminoazo-benzene | 31 | 51 | 17 | 67 | 106 | 16 | | |
| 3,3'-dimethoxybenzidine | 37 | 38 | 6 | 129 | 20 | 50 | | |
| o-anisidine | 39 | 39 | 4 | 149 | 67 | 17 | | |
| o-toluidine | 56 | 30 | 24 | 70 | 80 | 22 | | |
| benzidine | 65 | 119 | 8 | 95 | 8 | 81 | | |
| N,N,-dimethylaniline | 67 | 24 | 54 | 31 | 97 | 12 | | |
| aniline | 70 | 24 | 35 | 45 | 67 | 11 | | |
| 4,4'-methylene bis(2-chloroaniline) | 89 | 36 | 25 | 49 | 75 | 27 | | |
| 3,3'-dimethylbenzidine | 92 | 44 | 6 | 129 | 28 | 51 | | |
| N,N,diethylaniline | 95 | 19 | 54 | 31 | 104 | 16 | | |
| carbaryl | 99 | 19 | 125 | 51 | 94 | 22 | | |
| ethyl carbamate | 103 | 14 | 27 | 33 | 69 | 21 | | |

| Compound | First Field Test[a] | | Second Field Test[b] | | Laboratory Test[c] | | Margeson, *et al.* Two Field Tests[d] | |
|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| caprolactam | 114 | 12 | 22 | 107 | 91 | 18 | | |
| N-nitrosomorpholine | 116 | 12 | 81 | 26 | 85 | 23 | | |
| N-nitrosodimethylamine | 117 | 13 | 81 | 27 | 96 | 9 | | |
| propoxur | 123 | 12 | 75 | 61 | 97 | 20 | | |
| 2-acetylaminofluorene | 147 | 23 | 49 | 45 | 106 | 17 | | |
| styrene oxide | 0.5 | 1481 | not tested | | 49 | 66 | | |
| phthalic anhydride | 5 | 144 | not tested | | 2 | 136 | | |
| methoxychlor | 73 | 19 | 75 | 51 | 73 | 30 | | |
| toluene | 76 | 11 | 97 | 11 | 340 | 45 | 75/85 | 26/15 |
| m-/p-xylene | 79 | 12 | 79 | 12 | 104 | 9 | | |
| quinoline | 80 | 19 | 82 | 30 | 99 | 8 | | |
| styrene | 84 | 10 | 39 | 81 | 104 | 8 | | |
| o-xylene | 85 | 11 | 97 | 9 | 103 | 8 | 99 | 8 |
| 1,4-dioxane | 87 | 11 | 79 | 21 | 92 | 8 | 86 | 17 |
| cumene | 88 | 11 | 95 | 9 | 102 | 9 | | |
| ethylbenzene | 89 | 12 | 93 | 9 | 94 | 10 | | |
| parathion | 89 | 28 | 76 | 28 | 96 | 11 | | |
| isophorone | 93 | 12 | 96 | 13 | 106 | 13 | | |
| acetophenone | 96 | 12 | 98 | 13 | 132 | 12 | | |
| naphthalene | 96 | 11 | 94 | 10 | 107 | 8 | 106 | 16 |
| dibenzofuran | 100 | 12 | 103 | 12 | 110 | 11 | | |
| dichlorvos | 101 | 18 | 57 | 27 | 68 | 30 | | |
| DDE | 102 | 15 | 93 | 24 | 120 | 10 | | |
| 4-nitrobiphenyl | 102 | 14 | 104 | 10 | 104 | 12 | | |

| Compound | First Field Test[a] | | Second Field Test[b] | | Laboratory Test[c] | | Margeson, *et al.* Two Field Tests[d] | |
|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| heptachlor | 103 | 12 | 35 | 107 | 95 | 9 | | |
| biphenyl | 103 | 12 | 105 | 12 | 106 | 9 | | |
| lindane | 104 | 12 | 104 | 8 | 107 | 9 | | |
| nitrobenzene | 109 | 12 | 100 | 10 | 97 | 9 | 117 | 17 |
| 2,4-dinitrotoluene | 109 | 12 | 102 | 21 | 110 | 24 | | |
| methyl isobutyl ketone | 112 | 11 | 101 | 11 | 103 | 9 | | |
| chlordane | 142 | 16 | 85 | 25 | 93 | 14 | | |
| pyridine | not tested | | not tested | | not tested | | 82/71 | 24/18 |

a - Mean of 10-20 replicate quad train runs, with dynamic spiking. Coal-fired power plant. From references 15 & 16.
b - Mean of 8-19 replicate quad train runs, with dynamic spiking. Chemical manufacturing facility waste burner. From references 13 & 14.
c - Mean of 6-14 replicate quad train runs, with dynamic spiking. Source simulator. From references 11 & 16.
d - Mean of 13-39 replicate quad train runs, with dynamic spiking. Two hazardous waste incinerators. From reference 4.

Results for Method 0030 halogenated compounds laboratory study and four field tests.

| Compound | First Field Test[a] | | Second Field Test[b] | | Third Field Test[c] | | Laboratory Studies[d] | | Fuerst, *et al.* Field Test[e] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| Methyl Chloride (Chloromethane) | 937 | 53.8 | 243 | 62.8 | 255.3 | 58.1 | 101.2 | 8.10 | | |
| Ethylidene Dichloride (1,1-Dichloroethane) | 75.7 | 13.7 | 82.2 | 23.3 | 86.0 | 13.2 | 108.8 | 3.97 | | |
| Chlorobenzene | 88.2 | 22.0 | 81.2 | 22.1 | 84.8 | 27.9 | 94.2 | 14.56 | | |
| Vinyl Chloride | 110.4 | 27.3 | 41.8 | 44.6 | 37.3 | 39.5 | 90.4 | 12.01 | | |
| Vinylidene Chloride (1,1-Dichloroethylene) | 88.0 | 31.3 | 77.8 | 24.2 | 77.8 | 25.1 | 123.0 | 4.56 | | |
| Chloroform | 81.8 | 14.8 | 91.3 | 24.6 | 95.3 | 14.3 | 117.4 | 4.92 | 127 | 12 |
| Propylene Dichloride (1,2-Dichloropropane) | 67.2 | 9.6 | 121 | 24.8 | 117.7 | 30.0 | 98.0 | 9.52 | | |
| Methyl Bromide (Bromomethane) | 53.7 | 20.2 | 54.8 | 26.2 | 52.8 | 27.8 | 97.4 | 9.78 | | |
| Ethyl Chloride (Chloroethane) | 50.3 | 28.7 | 33.7 | 36.9 | 31.4 | 37.6 | 95.8 | 11.2 | | |
| Methylene Chloride | 77.7 | 27.1 | 89.9 | 14.3 | 90.8 | 11.7 | 101.6 | 2.84 | | |
| Methyl Chloroform (1,1,1-Trichloroethane) | 110 | 43.5 | 91.1 | 31.1 | 96.8 | 19.4 | 103.4 | 12.28 | | |
| Carbon Tetrachloride | 107 | 47.2 | 81.2 | 23.6 | 85.7 | 13.8 | 108.4 | 14.97 | 108 | 8 |
| Ethylene Dichloride (1,2-Dichloroethane) | 76.6 | 33.0 | 72.3 | 37.5 | 78.6 | 27.7 | 95.8 | 6.19 | | |
| Trichloroethylene | 126 | 15.6 | 119 | 26.2 | 124.0 | 16.8 | 110.0 | 6.88 | | |
| cis-1,3-Dichloropropene | 137 | 26.0 | 79.5 | 27.6 | 83.5 | 16.1 | 109.0 | 14.59 | | |
| trans-1,3-Dichloropropene | 135 | 38.1 | 52.3 | 35.4 | 47.9 | 35.0 | 96.6 | 18.00 | | |
| 1,1,2-Trichloroethane | 98.0 | 22.1 | 79.7 | 27.2 | 81.4 | 14.4 | 106.4 | 13.71 | | |
| Tetrachloroethene | 97.7 | 21.9 | 60.1 | 27.9 | 57.5 | 12.5 | 111.6 | 6.72 | 122 | 8 |
| Methyl Iodide (Iodomethane) | 72.8 | 37.6 | 79.5 | 63.1 | 77.8 | 20.4 | 108.4 | 5.28 | | |
| Allyl Chloride (3-Chloropropene) | 29.9 | 19.5 | 35.6 | 33.3 | 36.4 | 29.6 | 127.2 | 5.43 | | |
| Ethylene Dibromide (1,2-Dibromoethane) | 34.9 | 31.6 | 79.6 | 37.4 | 81.6 | 31.0 | 97.0 | 14.86 | | |
| Chloroprene | 40.1 | 22.4 | 72.4 | 23.0 | 76.4 | 12.3 | 104.2 | 4.31 | | |
| Vinyl Bromide | 60.7 | 34.3 | 29.8 | 29.7 | 28.4 | 30.9 | 110.8 | 9.30 | | |
| Trichlorofluoromethane (Freon 11) | not tested | | not tested | | not tested | | not tested | | 93 | 10 |

a - Mean of six replicate quad train runs, with dynamic spiking. Coal fired power plant. From references 8 & 9.
b - Mean of eight replicate quad train runs, with dynamic spiking. Organic chemical manufacturing facility. From references 9 & 31.
c - Mean of six replicate quad train runs, with dynamic spiking. Organic chemical manufacturing facility. From references 9, 27, 28 & 29.
d - Mean of five replicate quad train runs. Full scale sampling train, dynamic spike, stack simulator. From references 7 & 9.
e - Mean of 11-16 replicate quad train runs, with dynamic spiking. Hazardous Waste Combustor. From reference 25.

Results for Method 0030 nonhalogenated organic compounds, laboratory study and three field tests.

| Compound | First Field Test[a] | | Second Field Test[b] | | Laboratory Test[c] | | Fuerst, *et al.* Field Test[d] | |
|---|---|---|---|---|---|---|---|---|
| | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD | Percent Recovery | Percent RSD |
| 2,2,4-trimethylpentane | 63.1 | 18.3 | 75.9 | 27.7 | 69/83 | 13/11 | | |
| carbon disulfide | 63.8 | 23.6 | 42.0 | 27.7 | 54/60 | 21/15 | | |
| n-hexane | 79.2 | 22.6 | 92.9 | 23.5 | 88/105 | 13/8 | | |
| benzene | 106.3 | 25.6 | 100.1 | 23.6 | 66/99 | 7/6 | 106 | 6 |
| toluene | 77.9 | 17.5 | 98.8 | 30.3 | 60/* | 21/* | | |

a - Mean of 9 replicate quad train runs, with dynamic spiking. Coal-fired power plant. From references 16 & 34.
b - Mean of 11 replicate quad train runs, with dynamic spiking. Chemical manufacturing facility waste burner. From references 14 & 35.
c - Mean of 10 replicate quad train runs, with dynamic spiking at two concentration levels. Source simulator. From references 11 & 16.
d - Mean of 16 replicate quad train runs, with dynamic spiking. Hazardous waste combustor. From reference 25.
* - Invalid results due to laboratory contamination.

**Results for Method 0031 field test and Method 0040 field test.**

| Compound | Method 0031 | | Method 0040 | |
|---|---|---|---|---|
| | Mean Percent Recovery[a] | Percent RSD | Mean Percent Recovery[b] | Percent RSD |
| Methyl Chloride (Chloromethane) | 167.5 | 56.4 | 123 | 22.9 |
| 1,1-Dichloroethane | 96.2 | 12.6 | 93.7 | 21.8 |
| Chlorobenzene | 91.6 | 13.0 | not tested | |
| Vinyl chloride | 44.2 | 24.2 | 109 | 25.3 |
| Vinylidene Chloride (1,1-Dichloroethene) | 96.8 | 17.2 | 92.8 | 24.1 |
| Chloroform | 98.4 | 20.4 | not tested | |
| Propylene Dichloride (1,2-Dichloropropane) | 149.4 | 14.0 | not tested | |
| Methyl Bromide (Bromomethane) | 45.7 | 46.7 | 168 | 31.6 |
| Ethyl Chloride (Chloroethane) | 45.3 | 30.0 | not tested | |
| Methylene chloride | 120.7 | 10.9 | 93.4 | 25.8 |
| Methyl Chloroform (1,1,1-Trichloroethane) | 87.1 | 12.1 | 92.9 | 23.9 |
| Carbon tetrachloride | 89.3 | 12.5 | 101 | 21.6 |
| Ethylene Dichloride (1,2-Dichloroethane) | 83.2 | 25.1 | not tested | |
| Trichloroethene | 148.7 | 3.4 | not tested | |
| cis-1,3-Dichloropropene | 118.4 | 21.0 | not tested | |
| trans-1,3-Dichloropropene | 75.2 | 32.6 | not tested | |
| 1,1,2-Trichloroethane | 117.3 | 20.5 | 94.5 | 21.4 |
| Tetrachloroethene | 61.8 | 8.0 | not tested | |
| Methyl iodide (Iodomethane) | 89.0 | 11.9 | not tested | |
| Allyl Chloride (3-Chloropropene) | 26.0 | 21.1 | 82.0 | 25.6 |
| Ethylene Dibromide (1,2-Dibromoethane) | 108.5 | 23.2 | not tested | |
| Chloroprene | 85.8 | 15.3 | not tested | |
| Vinyl Bromide | 38.0 | 22.5 | 112 | 26.4 |
| Benzene | not tested | | 98 | 24.9 |
| 1,3-Butadiene | not tested | | 52.9 | 56.9 |
| Dichlorodifluoromethane (Freon 12) | not tested | | 51.1 | 60.9 |
| n-Hexane | not tested | | 94.0 | 20.5 |
| Toluene | not tested | | 84.7 | 29.8 |
| 2,2,4-Trimethylpentane | not tested | | 105 | 22.8 |
| Trichlorofluoromethane (Freon 11) | not tested | | 121 | 24.4 |

a - Mean of six replicate quad train runs, with dynamic spiking. Organic chemical manufacturing facility. From references 9, 28 & 29.

b - Mean of eleven replicate quad train runs, with dynamic spiking. Coal fired power plant. From references 1 & 2.

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## SOURCES OF METHODS AND INFORMATION

For the person trying to obtain current information or to enter into the field of source measurements, there are several particularly helpful information sources available. The U.S. EPA methods are in two groups, those used by EPA's Office of Air Quality Planning and Standards (OAQPS), and those used by EPA's Office of Solid Waste (OSW).

The Emission Measurement Technical Information Center (EMTIC) at Research Triangle Park, NC is supported by EPA's Office of Air Quality Planning and Standards. Perhaps the most efficient of several available forms of assistance is the EMTIC Bulletin Board System (BBS). Test methods are included, along with announcements, utility programs, miscellaneous documents, and other information. The EMTIC/BBS may be reached through TTN 2000 on the Internet at http://www.epa.gov/ttn. An EMTIC representative can be reached by telephone at 919-541-0200. EMTIC sponsors workshops and training courses jointly with EPA's Air Pollution Training Institute. Training video tapes, a newsletter, and other mailings are also available from EMTIC.

An excellent source for information concerning OSW's SW-846 Methods is the Methods Information Communication Exchange (MICE). MICE can be reached on the Internet at mice@lan828.ehsg.saic.com. A telephone call to the MICE line, at 703-821-4690, will put the information seeker in touch with an automated information service or with a live representative. Although the function of MICE is to provide information, they will usually send copies of up to three methods. They will not provide copies of the entire SW-846 Methods Manual. The SW-846 Methods Manual, may be obtained on CD-ROM or hard copy from National Technical Information Service (NTIS). The NTIS order number for the CD-ROM which includes the third edition and updates 1-3 is PB97-501928INQ. NTIS has a web site at http://www.ntis.gov. and may also be reached by telephone at 703-487-4650. SW-846 may also be obtained from the Government Printing Office (GPO). Ordering information for GPO is--

*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 Manual, 3rd ed.* Document No. 955-001-000001. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC, November 1986.

The full document is available from U. S. Government Printing Office, telephone 202-783-3238. GPO also has a website at http://www.access.gpo.gov.

For more information or copies of the California Environmental Protection Agency, Air Resources Board Methods ( a.k.a. CARB Methods), contact http://www.arb.ca.gov/testmeth/testmeth.htm or telephone Engineering and Laboratory Branch at 916-263-1630.

EPA reports may be ordered from NTIS at the web site or telephone number given above.