WSC – CAM – IX B

Quality Control Requirements and Performance Standards for the ***Analysis of Volatile Organic Compounds in Air Samples (TO-15) by Gas Chromatography/Mass Spectrometry (GC/MS)*** in Support of Response Actions under the Massachusetts Contingency Plan (MCP)

IX. Air Sampling Methods

B. Quality Control Requirements and Performance Standards for WSC-CAM-IX B (VOCs in Air Samples [TO-15] by GC/MS)

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ACRONYNM LIST

BFB	**Bromofluorobenzene**	**NA**	**Not applicable**
CAM	**Compendium of Analytical Methods**	**ppbV**	**Parts per billion (volume)**
CASN	**Chemical Abstracts Service Number**	**r**	**Correlation coefficient**
CCAL	**Continuing calibration**	**r^2**	**Coefficient of determination**
%D	**Percent difference or percent drift**	**%R**	**Percent recovery**
DF	**Dilution factor**	**RPD**	**Relative percent difference**
GC	**Gas chromatograph**	**%RSD**	**Percent relative standard deviation**
GC/MS	**Gas chromatography/mass spectrometry**	**QA**	**Quality assurance**
ICV	**Initial calibration verification**	**QC**	**Quality control**
In. Hg	**Inches of mercury**	**RAO**	**Response Action Outcome**
IRAs	**Immediate Response Actions**	**RL**	**Reporting limit**
LCS	**Laboratory control sample**	**SIM**	**Selected ion monitoring**
MassDEP	**Massachusetts Department of Environmental Protection**	**UCM**	**Unresolved complex mixture**
		$\mu g/m^3$	**micrograms per cubic meter**
MCP	**Massachusetts Contingency Plan**	**VOCs**	**Volatile organic compounds**
MD	**Matrix duplicate**		

1.0 Quality Control Requirements and Performance Standards for WSC-CAM-IX B

1.1 Overview of WSC-CAM-IX B

WSC-CAM-IX B, *Quality Control Requirements and Performance Standards for the Analysis of Volatile Organic Compounds (VOCs) in Air Samples (TO-15) by Gas Chromatography/Mass Spectrometry (GC/MS) in Support of Response Actions under the Massachusetts Contingency Plan (MCP)*, is a component of MassDEP's Compendium of Analytical Methods (CAM). Refer to WSC-CAM-I A for an overview of the CAM process.

This document provides Quality Control (QC) requirements and performance standards to be used in conjunction with EPA Method TO-15, *Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*. The QC requirements and performance standards specified in this document in Table IX B-1 together with the analytical procedures described in EPA Method TO-15 constitute the WSC-CAM-IX B protocol. All protocols included in the CAM are considered "methods" published by the MassDEP pursuant to the provisions of 310 CMR 40.0017(2). Use of EPA Method TO-15 is a "Presumptive Certainty" requirement of WSC-CAM-IX B. Sample preservation, container and analytical holding time specifications for air matrices for VOCs analyzed in support of MCP decision-making are presented in Appendix IX B-1 of this document and Appendix VII-A of WSC-CAM-VII A *Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data in Support of Response Actions Conducted Under the Massachusetts Contingency Plan (MCP)*. General data reporting requirements are also provided in WSC-CAM-VII A. Reporting requirements specific to the air sampling protocol are provided in Section 3.2 of this CAM protocol.

Overall usability of data produced using this CAM protocol should be evaluated for compliance with project-specific data quality objectives, regardless of "Presumptive Certainty" status. For more guidance on data usability, refer to MassDEP Policy #WSC-07-350, *MCP Representativeness Evaluations and Data Usability Assessments*.

1.1.1 Reporting Limits for WSC-CAM-IX B

The reporting limit (RL) for an individual compound using WSC-CAM-IX B is dependent on the concentration of the lowest non-zero standard in the initial calibration, analyzed under identical conditions as the sample, with adjustments made for dilution factors, etc., as required.

The CAM RLs for WSC-CAM-IX B target analytes using the full scan mode of operation are:

- 2-5 µg/m^3 (0.1-0.5 parts per billion by volume [ppbV]).

The CAM RLs for WSC-CAM-IX B target analytes using the selected ion monitoring (SIM) mode of operation are:

- 0.2-0.5 µg/m^3 (0.01-0.05 parts per billion by volume [ppbV]).

These values are readily achievable using GC/MS. There may be exceptions to the above CAM RLs for some target analytes (that is, the CAM RL for some target analytes may not be readily achieved by a laboratory using WSC-CAM-IX B). In general, acetone will likely exhibit an RL 2-5 times higher than the CAM RLs listed above. For "Presumptive Certainty" purposes, if the CAM RLs are not achieved, respond "NO" to Question G of the "MassDEP MCP Analytical Protocol Certification Form" and address the CAM RL exceedance in the laboratory narrative.

Reporting limits lower than the above-referenced full scan CAM RLs for WSC-CAM IX B target analytes may be required to satisfy project requirements. The RL (based on the concentration of the lowest calibration standard) for each contaminant of concern must be less than or equal to the MCP standards or criteria that the contaminant concentrations are being compared to (e.g., MassDEP Indoor Air Threshold Values, background, etc.). Meeting MCP standards or criteria may require analytical modifications, such as the use of SIM, an ion trap mass spectrometer, or other instrumentation of improved design to improve sensitivity. All such modifications must be described in the laboratory narrative. Regardless of the instrument that is used, RLs for the WSC-CAM IX B target analytes will be proportionately higher for samples that require dilution.

1.1.2 Initial Demonstration of Proficiency for WSC-CAM-IX B

Each laboratory that uses the WSC-CAM-IX B protocol is required to operate a formal quality assurance program. The minimum requirements of this program consist of an initial demonstration of laboratory proficiency, ongoing analysis of standards and blanks to confirm acceptable continuing performance, and the analysis of laboratory control samples (LCSs) and matrix duplicates to assess analytical accuracy and precision.

Laboratories must document and have on file an Initial Demonstration of Proficiency. These data must meet or exceed the performance standards as presented in Table IX B-1 of this protocol and the EPA Method TO-15. The Initial Demonstration of Proficiency includes an initial demonstration of accuracy and precision. The following procedure must be used:

- Analyze a minimum of 4 replicate samples of a Calibration Check Standard.
- Calculate the measured concentrations of each analyte in all replicates, the mean accuracy (as a percentage of the true value) for each analyte, and the precision (as %RSD) of the measurements for each analyte.
- For each analyte, the mean accuracy, expressed as a percentage of the true value (i.e., recovery), must be between 70% and 130%, and the replicate precision, expressed as %RSD, must be ≤ 25. The Initial Demonstration of Proficiency must meet these conditions for analysis to proceed.

The data associated with the Initial Demonstration of Proficiency must be kept on file at the laboratory and made available to potential data users on request. The data associated with the Initial Demonstration of Proficiency for WSC-CAM-IX B must include the following information:

QC Element	Performance Criteria
BFB Tuning	WSC-CAM-IX B, Table IX B-1
Initial Calibration	WSC-CAM-IX B, Table IX B-1
Continuing Calibration	WSC-CAM-IX B, Table IX B-1
Method Blanks	WSC-CAM-IX B, Table IX B-1
Average Recovery	70-130%
% Relative Standard Deviation	%RSD ≤ 25
Internal Standards	WSC-CAM-IX B, Table IX B-1

NOTE: Because of the extensive analyte list and number of QC elements associated with the Initial Demonstration of Proficiency, it should be expected that one or more analytes may not meet the performance standard for one or more QC elements. Under these circumstances, the analyst should attempt to locate and correct the problem and repeat the analysis for all non-conforming analytes. All non-conforming analytes along with the laboratory-specific acceptance criteria should be noted in the Initial Demonstration of Proficiency documentation.

It is essential that laboratory-specific performance criteria for LCS recoveries also be calculated and documented as described in SW-846 Method 8000B, Section 8.7. Experience indicates that the criteria recommended in specific methods are frequently not met for some analytes and/or matrices; the in-house performance criteria will be a means of documenting these repeated exceedances. Laboratories are encouraged to actively monitor pertinent QC performance standards described in Table IX B-1 to assess analytical trends (i.e., systematic bias, etc) and improve overall method performance by preempting potential non-conformances.

For the WSC-CAM-IX B protocol, laboratory-specific control limits must meet or exceed (demonstrate less variability than) the performance standards for each QC element listed in Table IX B-1. It should be noted that the performance standards listed in Table IX B-1 are based on multiple-laboratory data, which are in most cases expected to demonstrate more variability than performance standards developed by a single laboratory.

This protocol is restricted to use by, or under the supervision of, analysts experienced in the use of GC/MS instrumentation as a quantitative tool and skilled in the interpretation of chromatograms and mass spectra.

1.2 Summary of EPA Method TO-15

Samples are collected in pre-cleaned, evacuated, passivated stainless steel canisters. A concentrator system is used for the automated collection, trapping, focusing, and injection of measured aliquots removed from the sample containers. Depending on the water retention properties of the packing, some or most of the water vapor contained in the sample completely passes through the concentrator during this process. Additional drying of the “trapped” sample aliquot, if required, is accomplished by forward purging the trap with clean, dry helium (or other inert gas).

Following preconcentration, the sample is transferred and cryogenically refocused onto the inlet of a capillary column on a gas chromatograph (GC). The GC oven is temperature-programmed to facilitate separation of the target analytes. All compounds are detected using a mass spectrometer that is interfaced directly to the GC. Target analytes are identified and quantified using characteristic ions. Identification of target analytes is accomplished by comparing sample electron impact mass spectra with the electron impact mass spectra of standards obtained under identical analytical conditions. Average response factors (or calibration curves) are used to calculate individual concentrations of the target analytes.

1.3 Method Interferences

- Refer to EPA Method TO-15 for a detailed description of chemical contaminants, cross-contamination, and corrective actions which may be taken to eliminate contamination. If a method blank contains a contaminant, data for samples associated with that blank must **not** undergo "blank correction" (i.e., if an associated sample also contains the contaminant, subtraction of the blank amount from the sample amount is not permitted).

- Cross-contamination may occur when any sample is analyzed immediately after a sample containing high concentrations of VOCs. After the analysis of a sample containing high concentrations of VOCs, one or more blanks should be analyzed to check for potential cross-contamination/carryover. Concentrations of VOCs which exceed the upper limit of calibration should prompt the analyst to check for potential cross-contamination/carryover.

- High methane levels and/or carbon dioxide levels may interfere with the chromatography. Dilution may be performed on samples to minimize this effect; however, the RLs for diluted samples will be proportionately increased. It should be noted that although the concentrator systems must be designed to minimize elevated levels of carbon dioxide, the potential still exists to have interfering levels.

1.4 Quality Control Requirements for WSC-CAM-IX B

1.4.1 General QC Requirements

Refer to SW-846 Method 8000B for general QC procedures for all chromatographic methods. Instrument QC and method performance requirements for the GC/MS system may be found in Section 10 of the EPA Method TO-15.

1.4.2 Specific QC Requirements and Performance Standards for WSC-CAM-IX B

Specific QC requirements and performance standards for the WSC-CAM-IX B protocol are presented in Table IX B-1. Refer to WSC-CAM-VII A for field QC requirements. Strict compliance with the QC requirements and performance standards, as well as satisfying the CAM's other analytical and reporting requirements will provide a data user with "Presumptive Certainty" in support of Response Actions under the MCP. The concept of "Presumptive Certainty" is explained in detail in Section 2.0 of WSC-CAM-VII A.

While optional, parties electing to utilize these protocols will be assured of "Presumptive Certainty" of data acceptance by agency reviewers. In order to achieve "Presumptive Certainty" for analytical data, parties must:

(a) Use the analytical method specified for the selected CAM protocol;
(b) Incorporate **all** required analytical QC elements specified for the selected CAM protocol;
(c) Implement, as necessary, required corrective actions and analytical response actions for **all** non-conforming analytical performance standards;
(d) Evaluate and narrate, as necessary, **all** identified CAM protocol non-compliances; and
(e) Comply with **all** the reporting requirements specified in WSC-CAM-VII A, including retention of reported and unreported analytical data and information for a period of ten (10) years.

In achieving "Presumptive Certainty" status, parties will be assured that analytical data sets:

- ✓ Satisfy the broad QA/QC requirements of 310 CMR 40.0017 and 40.0191 regarding the scientific defensibility, precision and accuracy, and reporting of analytical data; and

- ✓ May be used in a data usability and representativeness assessment, as required in 310 CMR 40.1056(2)(k) for Response Action Outcome (RAO) submittals, consistent with the guidance described in MassDEP Policy #WSC-07-350, *MCP Representativeness Evaluations and Data Usability Assessments*.

1.5 Special Analytical Considerations for WSC-CAM-IX B

The following bullets highlight potential issues that may be encountered with the analysis of VOCs in air using this protocol.

- The canister pressure of all grab and time-integrated samples must be measured and documented upon receipt at the laboratory. An annually calibrated NIST-traceable vacuum/pressure gauge is attached to the canister inlet, the sampling valve is briefly opened and the pressure is recorded. If the canister vacuum upon receipt is >15 inches of mercury (in. Hg) or if the canister vacuum measured upon receipt at the laboratory differs from the final canister vacuum measured in the field by more than ±5 in. Hg, the client should be contacted to determine if analysis should proceed. If client indicates that the analysis should proceed, the noted anomalies should be documented on the data report form or the laboratory narrative.

- It should be noted that analysis of 2-methylnaphthalene in air samples may be required at certain sites. Due to the semivolatile nature of this compound and its erratic performance with being analyzed from canisters, this compound was not included on the WSC-CAM-IX B compound list. If analysis of this compound in the air matrix is required, a non-CAM method (e.g., EPA Method TO-13) may be required.

- As noted on the target analyte list (Table IX B-2), many compounds may require analysis in the SIM mode of operation in order to achieve regulatory limits. The data user must communicate the need for SIM analysis before the sampling event has begun in order for the laboratory to properly certify the canisters as clean for SIM analysis.

- It should be noted that laboratories may pressurize samples with ultra zero air or ultra high purity nitrogen upon receipt. This may be performed as standard practice within the laboratory or only for

samples which arrive at the laboratory with high vacuum levels (i.e., >15 in. Hg). If this is performed, the resulting dilution factor must be incorporated into the final result calculations. Pressurization should only be performed if samples contain high vacuum or if the reporting limits will not be adversely affected (i.e., above regulatory limits) as a result of the pressurization.

- A linear or non-linear calibration model must not be used to compensate for detector saturation or to avoid proper instrument maintenance. As such, linear or non-linear regression must not be employed for initial calibration calculations that typically meet percent relative standard deviation (%RSD) requirements specified in Table IX B-1.

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
Initial Demonstration of Proficiency	Laboratory Analytical Accuracy & Precision	(1) Must be performed prior to using method on samples. (2) Must contain all target analytes. (3) Must follow procedure in Section 1.1.2 of this protocol.	No	NA	See Section 1.1.2 of this protocol.	NA
GC/MS Tunes with BFB	Inter-laboratory Consistency & Comparability	(1) Criteria listed in Table 3 of EPA Method TO-15. (2) Every 24 hours prior to sample analysis.	No	NA	Perform instrument maintenance as necessary; retune instrument.	Suspend all analyses until tuning non-compliance is rectified.
Initial Calibration	Laboratory Analytical Accuracy	(1) Must be analyzed at least once prior analyzing samples, when continuing calibration does not meet the performance standards, and when major instrument maintenance is performed. (2) Minimum of 5 standards (or 6 if non-linear regression used). (3) Low standard must be ≤RL. (4) %RSD ≤30 (except naphthalene ≤40), r ≥0.99 (linear regression), or r^2 ≥0.99 (non-linear regression) for each target analyte. (5) If %RSD >30 (or 40 for naphthalene), linear or non-linear regression must be used. (6) Must contain all target analytes. (7) Calibration must be performed under the same conditions as the samples. (8) If linear or non-linear regression used, verify the RL by recalculating concentrations in lowest calibration standard using the final calibration curve; recoveries must be 70-130% (except naphthalene 60-140%). (9) SIM: Laboratory must monitor a minimum of two ions per analyte (the	No	NA	(1) Recalibrate if target analytes exceed %RSD, "r", or "r^2" criteria. (2) If recalculated concentrations from the lowest calibration standard are outside 70-130% (or 60-140% for naphthalene) recovery range, either: * The RL must be reported as an estimated value[2], or * The RL must be raised to the concentration of the next highest calibration standard that exhibits acceptable recoveries when recalculated using the final calibration curve.	Sample analysis cannot proceed without a valid initial calibration. Report non-conforming compounds or ranges (%RSD >30 or 40 [for naphthalene], r <0.99, or r^2 <0.99) in laboratory narrative. If non-linear regression (i.e., quadratic equation) is used for calibration, this must be noted in the laboratory narrative along with the compounds affected.

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
		primary ion or quantitation ion and a minimum of one confirmation ion); this is required for all target analytes and internal standards.				
Initial Calibration Verification	Laboratory Analytical Accuracy	Refer to LCS; ICV replaced with LCS.	No	NA	Refer to LCS; ICV replaced with LCS.	Refer to LCS; ICV replaced with LCS.
Continuing Calibration	Laboratory Analytical Accuracy	(1) Every 24 hours prior to the analysis of samples. (2) Concentration level near midpoint of curve. (3) Must contain all target analytes. (4) %D must be ≤30 for each target analyte.	No	NA	Recalibrate if >20% of target analytes exceed %D criteria. If ≤20% of compounds exceed criteria, recalibration is not required as long as %D <50.	Report non-conforming compounds (%D >30) and associated samples in laboratory narrative.
Method Blank	Laboratory Method Sensitivity (contamination evaluation)	(1) Every 24 hours prior to the analysis of samples. (2) Target analytes must be <RL.	Yes	NA	(1) If concentration of contaminant in sample is <10x concentration in blank, locate source of contamination; correct problem; reanalyze method blank and associated samples. (2) No corrective action required if concentration of contaminant in sample is >10x concentration in blank or if contaminant not detected in sample.	(1) If sample reanalysis is not possible, report non-conformance in laboratory narrative. (2) If contamination of method blanks is suspected or present, the laboratory, using a "B" or some other convention, should qualify the sample results. Blank contamination should also be documented in the laboratory narrative. (3) If re-analysis is performed within holding time and yields acceptable method blank results, the laboratory may report results of the

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
						re-analysis only. (4) If re-analysis is performed outside of holding time, the laboratory must report results of both the initial analysis and re-analysis.
Laboratory Control Sample (LCS)	Laboratory Analytical Accuracy	(1) Every 24 hours and after an initial calibration. (2) Concentration level near midpoint of curve. (3) Must contain all target analytes. (4) Percent recoveries must be between 70-130% for target analytes except for "difficult" analytes(**) which must exhibit percent recoveries between 50-150%.	Yes	Recovery <10%; affects nondetect results for affected analyte in all samples analyzed under this LCS.	(1) If recoveries are low (<50% for "difficult" analytes [**] and <70% for remaining compounds), reanalyze LCS and associated samples. (2) If recoveries are high (>150% for "difficult" analytes [**] and >130% for remaining compounds), reanalyze LCS and associated samples if affected compounds were detected in associated samples; otherwise, reanalysis not required.	(1) If sample re-analysis is not possible report non-conformance in laboratory narrative. (2) If recovery is outside of 70-130% (50-150% for "difficult" analytes [**]) for any analyte, report non-conforming compounds in laboratory narrative. (3) If re-analysis is performed within holding time and yields acceptable LCS results, the laboratory may report results of the re-analysis only. (4) If re-analysis is performed outside of holding time, the laboratory must report results of both the initial analysis and re-analysis.
Matrix Duplicate	Method Precision in Sample Matrix	(1) Every 24 hours (sample selected at discretion of laboratory or at request of data user). (2) RPDs ≤25 for results >5x the RL.	Yes ONLY when requested by the data user	NA	Narrate non-conformance.	Note exceedances in laboratory narrative.

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
Internal Standards	Laboratory Analytical Accuracy and Method Accuracy in Sample Matrix	(1) Minimum of 3 at retention times across GC run. Recommended internal standards are: Bromochloromethane 1,4-Difluorobenzene Chlorobenzene-d5 (2) Area counts in samples must be between 60-140% of the area counts in the associated continuing calibration standard. (3) Retention times of internal standards must be within ±0.33 minutes of retention times in associated continuing calibration standard.	Yes	Recovery <20%; affects all nondetect results quantitated using affected internal standard in associated sample.	If one or more internal standards are outside of limits, reanalyze sample unless obvious interference present (e.g., UCM). NOTE: If obvious interference is present and internal standard area would cause rejection of data (i.e., <20%), reanalyze sample on dilution.	(1) Report nonconformances in laboratory narrative. Include actual recovery of internal standard and provide summary of analytes quantitated using the internal standard. (2) If reanalysis yields similar internal standard non-conformances, the laboratory must report results of both analyses. (3) If reanalysis is performed within holding time and yields acceptable internal standard recoveries, the laboratory may report results of the reanalysis only. (4) If reanalysis is performed outside of the holding time and yields acceptable internal standard recoveries, the laboratory must report results of both analyses. (5) If sample is not reanalyzed due to obvious interference, the laboratory must provide the chromatogram in the data report.

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
Quantitation	NA	(1) Quantitation must be based on internal standard calibration. (2) The laboratory must use the average response factor or linear or non-linear regression curve generated from the associated initial calibration for quantitation of each target analyte. (3) The internal standard used for quantitation should be the one nearest the retention time of the subject analyte. (4) Results must be reported with 2 or more "significant figures" if ≥ RL. If reporting values below the RL, report with 1 or more "significant figures".[3]	NA	NA	NA	NA
Identification	NA	(1) The relative retention time (RRT) of the target analyte in the sample must agree with the RRT of the target analyte in the associated continuing calibration standard within ± 0.33 minutes; and (2) The relative intensities of the primary (quantitation) and secondary ions (Table 2 of EPA Method TO-15) for the target analyte in the sample must agree within ± 20% of the relative intensities of the same ions in the continuing calibration standard. Note that several analytes on the WSC-CAM-IX B list are not included in Table 2 of the EPA Method TO-15; the primary and secondary ions for these analytes are provided in the footnote of this table[4].	NA	NA	NA	NA
Media Certification	Laboratory and Field Analytical Accuracy	(1) Batch or individual canister certification must be performed, as directed by the data user. (2) Canister certifications: target analytes must be <RL.	Yes	NA	(1) Reclean canisters until certifications pass the acceptance criteria. Canisters must not be sent out for field sampling	Report nonconformances in laboratory narrative.

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
		(3) Flow controller calibration must be verified by the laboratory prior to sample collection and upon receipt with the samples. (4) RPD of the pre- and post-flow controller calibration checks should be ≤20.			without an acceptable certification. (2) Narrate flow controller RPD non-conformances.	
General Reporting Issues	NA	(1) The full analyte list in Table IX B-2 must be reported in order to obtain Presumptive Certainty. (2) The laboratory must only report values ≥ the sample-specific reporting limit; optionally, values below the sample-specific reporting limit can be reported as estimated, if requested. The laboratory must report results for samples and blanks in a consistent manner. (1) Dilutions: If diluted and undiluted analyses are performed, the laboratory should report results for the lowest dilution within the valid calibration range for <u>each</u> analyte. The associated QC (e.g., method blanks, LCSs) for each analysis must be reported. (2) Refer to Section 3.3, TICs by GC/MS, for guidance. (3) Refer to Appendix IX B-1 for chain-of-custody requirements regarding preservation and holding times. (4) Chain-of-custody documentation requirements must be completed by the sampler as per Section 3.2 of this protocol.	NA	NA	NA	(1) Qualification of the data is required if reporting values below the sample-specific reporting limit. (2) Complete analytical documentation for diluted and undiluted analyses must be made available for review during an audit. (3) TICs will be evaluated at the discretion of the data user consistent with the guidelines presented in Appendix IX B-3. (4) The performance of dilutions must be documented in the laboratory narrative or on the report form. Unless due to elevated concentrations of target compounds, reasons for dilutions must be explained in the laboratory narrative. (5) If canister vacuum on receipt is >15 in. Hg or if the laboratory receipt canister vacuum differs from final field vacuum

Table IX B-1: Specific QC Requirements and Performance Standards for VOCs in Air (EPA Method TO-15) Using WSC-CAM-IX B

Required QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable?	Rejection Criteria per WSC-07-350[1]	Required Corrective Action	Required Analytical Response Action
						by more than ±5 in Hg, the data user should be contacted before analysis can proceed; the canister pressure anomalies must be explained in the laboratory narrative. (6) If samples are analyzed outside of holding time, note the nonconformance in the laboratory narrative.

** Potentially "difficult" analytes include: hexachlorobutadiene, 1,2,4-trichlorobenzene, naphthalene, acetone, and 1,4-dioxane

[1]As per Appendix IV of MassDEP Policy #WSC-07-350, *MCP Representativeness Evaluations and Data Usability Assessments*, September 2007, if these results are observed, data users should consider nondetect results as unusable and positive results as estimated with a significant low bias.

[2]If the RL is estimated due to unacceptable recovery of the lowest standard, the CAM RL has not been achieved; Question G of the "MassDEP MCP Analytical Protocol Certification Form" must be answered "NO" and this must be addressed in the laboratory narrative.

[3]Reporting protocol for "significant figures" is a policy decision included for standardization and consistency for reporting of results and is not a definition of "significant" in the scientific or mathematical sense.

[4]Primary and Secondary ions for WSC-CAM-IX B Analytes that are not in Table 2 of the TO-15 method:

Acetone: 43/58
Bromodichloromethane: 83/85/129
Dibromochloromethane: 129/127/131
1,2-Dichlorobenzene: 146/75/111
1,3-Dichlorobenzene: 146/75/111
Cis-1,2-Dichloroethene: 61/96/98
Trans-1,2-Dichloroethene: 61/96/98
Trans-1,3-Dichloropropene: 75/39/7
Naphthalene: 128/102

1.6 Analyte List for WSC-CAM-IX B

The MCP analyte list for WSC-CAM-IX B is presented in Table IX B-2. The list is comprised of potential contaminants that are readily-analyzable by WSC-CAM-IX B and is intended to be protective of human health and the environment.

It is the responsibility of the data user, in concert with the laboratory, to establish the range and required RL for the target analytes. Sources of various MassDEP standards and criteria include MassDEP's *Typical Indoor Air Concentrations* (2008) and the MCP No Significant Risk criteria.

1.6.1 Analyte List Reporting Requirements for WSC-CAM-IX B

As described in Table IX B-1, reporting the full WSC-CAM-IX B analyte list is a "Presumptive Certainty" data requirement for this protocol.

In addition, it is the responsibility of the data user, in concert with the laboratory, to establish a site-specific target analyte list for the WSC-CAM-IX B protocol that includes all identified site contaminants of concern (in addition to those included in the protocol's target analyte list) that may pose a potential indoor risk and are analyzable by EPA Method TO-15. For purposes of complying with this requirement, compounds analyzable by EPA Method TO-15 are those compounds included in Table 2, *Characteristic Masses (M/Z) Used For Quanitfying The Title III Clean Air Act Amendment Compounds*, of EPA Method TO-15.

Note: a data user who avoids the detection and quantitation of a contaminant that is present or likely present at a site above background levels by limiting an analyte list could be found in criminal violation of MGL c. 21E or any regulations or orders adopted or issued thereunder.

Analytical Note:	Several analytes, which are not included in EPA Method TO-15, Table 2, are included as a WSC-CAM-IX B protocol target analyte; see footnote 4 on Table IX B-1.

Table IX B-2: Analyte List for WSC-CAM-IX B (EPA TO-15)

Analyte	CASN
Acetone	67-64-1
Benzene	71-43-2
Bromodichloromethane[1]	75-27-4
Bromoform	75-25-2
Bromomethane[1]	74-83-9
Carbon Tetrachloride[1]	56-23-5
Chlorobenzene	108-90-7
Chloroform	67-66-3
Dibromochloromethane[1,2]	124-48-1
Dichlorobenzene, 1,2- (o-DCB)[1]	95-50-1
Dichlorobenzene, 1,3- (m-DCB)[1]	541-73-1
Dichlorobenzene, 1,4- (p-DCB)[1]	106-46-7
Dichloroethane, 1,1-	75-34-3
Dichloroethane, 1,2-[1]	107-06-2
Dichloroethylene, 1,1-	75-35-4
Dichloroethylene, Cis-1,2-	156-59-2
Dichloroethylene, Trans-1,2-	156-60-5
Dichloromethane (Methylene chloride)	75-09-2
Dichloropropane, 1,2-[1]	78-87-5
Dichloropropene, cis-1,3-[1]	10061-01-5
Dichloropropene, trans-1,3-[1]	10061-02-6
Dioxane, 1,4-[1]	123-91-1
Ethylbenzene	100-41-4
Ethylene Dibromide[1,2]	106-93-4
Hexachlorobutadiene[1,2]	87-68-3
Methyl Ethyl Ketone	78-93-3
Methyl Isobutyl Ketone	108-10-1
Methyl Tert Butyl Ether	1634-04-4
Naphthalene[1]	91-20-3
Styrene	100-42-5

Table IX B-2: Analyte List for WSC-CAM-IX B (EPA TO-15)

Analyte	CASN
Tetrachloroethane, 1,1,2,2-[1,2]	79-34-5
Tetrachloroethylene	127-18-4
Toluene	108-88-3
Trichlorobenzene, 1,2,4-	120-82-1
Trichloroethane, 1,1,1-	71-55-6
Trichloroethane, 1,1,2-[1]	79-00-5
Trichloroethylene[1]	79-01-6
Vinyl Chloride[1]	75-01-4
Xylenes (Mixed Isomers)	1330-20-7

[1]Standard RL for this compound in the full scan mode of operation may not be able to achieve regulatory compliance limit.

[2]Standard RL for this compound in the SIM mode of operation may not be able to achieve regulatory compliance limit.

CASN – Chemical Abstracts Service Numbers

NOTE: Other VOCs may also be analyzed using the WSC-CAM-IX B Protocol but are not considered part of the CAM target analyte list.

2.0 Data Usability Assessment

Specific guidance applicable to all Class A, B or C RAO Statements, including partial RAOs, for preparation of Representativeness Evaluations and Data Usability Assessments pursuant to 310 CMR 40.1056(2)(k) of the MCP is provided in *MCP Representativeness Evaluations and Data Usability Assessments* (Policy #WSC-07-350). This document provides general information regarding the purpose and content of these required evaluations as a component of and in support of an RAO submittal. The most current version of this document may be found at the following URL: https://www.mass.gov/site-cleanup-regulations-policies-forms-more.

Overall usability of data produced using this CAM protocol should be evaluated for compliance with project-specific data objectives using MassDEP Policy #WSC-07-350, regardless of "Presumptive Certainty" status.

3.0 Reporting Requirements for WSC-CAM-IX B

3.1 General Reporting Requirements for WSC-CAM-IX B

General environmental laboratory reporting requirements for analytical data used in support of assessment and evaluation decisions at MCP disposal sites are presented in WSC-CAM-VII A, Section 2.4. This guidance document provides limited recommendations for field QC, as well as the required content of the laboratory report, which includes:

- Laboratory identification information,
- Analytical results and supporting information,
- Sample- and batch-specific QC information,
- Laboratory Report Certification Statement,
- Copy of the Analytical Protocol Certification Form,
- Laboratory narrative contents, and
- Chain-of-custody form requirements.

3.2 Specific Reporting Requirements for WSC-CAM-IX B

Specific QC requirements and performance standards for WSC-CAM-IX B are presented in Table IX B-1. Specific reporting requirements for WSC-CAM-IX B are summarized below in Table IX B-3 as "Required Analytical Deliverables (**YES**)". These routine reporting requirements must always be included as part of the laboratory deliverable for this method. It should be noted that although certain items are not specified as "Required Analytical Deliverables (**NO**)", these data must be available for review during an audit and may also be requested on a client-specific basis.

Table IX B-3 Routine Reporting Requirements for WSC-CAM-IX B (EPA TO-15)

Parameter	Required Analytical Deliverable
GC/MS Tunes	***NO***
Initial Calibration	***NO***
Initial Calibration Verification	***NO***
Continuing Calibration (CCAL)	***NO***
Method Blank	***YES***
Media Certification (canister and flow controller)	***YES***
Laboratory Control Samples (LCSs)	***YES***
Matrix Duplicate (MD)	***YES (if requested by data user)***
Internal Standards	***YES***
Tentatively Identified Compounds	***YES (if requested by data user)***
Identification and Quantitation	***NO***
General Reporting Issues	***YES***
Other Air-Specific Reporting Requirements	
Pre-Sampling Information (Provided by Laboratory)	
Canister vacuum	***YES***
Canister serial number	***YES***
Flow controller serial number	***YES (if used)***
Date canister released from the laboratory	***YES***
Sampling Information (Provided By Sampler)	
Canister serial number for each sample identification	***YES***
Sampling duration	***YES (if time-integrated samples)***
Flow controller serial number for each sample identification	***YES (if used)***
Initial and final canister vacuums	***YES***
Post-Sampling Information (Provided by Laboratory)	
Vacuum of canister upon receipt at laboratory	***YES***
Flow controller calibration RPD	***YES (if used)***

3.2.1 Sample Dilution

Under circumstances that sample dilution is required because either the concentration of one or more of the target analytes exceed the concentration of their respective highest calibration standard or any non-target peak

exceeds the dynamic range of the detector (i.e., "off scale"), the RL for each VOC target analyte must be adjusted (increased) in direct proportion to the Dilution Factor (DF).

The revised RL for the diluted sample, RL_d:

$$RL_d = DF \text{ X Lowest Calibration Standard for Target Analyte}$$

It should be understood that samples with elevated RLs as a result of a dilution may not be able to satisfy MCP standards/criteria in some cases if the RL_d is greater than the applicable MCP standard or criterion to which the concentration is being compared. Such increases in RLs are the unavoidable but acceptable consequence of sample dilution that enable quantification of target analytes which exceed the calibration range. All dilutions must be fully documented in the laboratory narrative.

NOTE: **Over dilution is an unacceptable laboratory practice.** The post-dilution concentration of the target analyte with the highest concentration must be at least 60 to 80% of its associated highest calibration standard. This will avoid unnecessarily high RLs for other target analytes which did not require dilution.

NOTE: **Dilution factors must also be taken into account if canisters are pressurized prior to analysis.**

3.3 Tentatively Identified Compounds (TICs) by GC/MS

The evaluation of TICs in conjunction with GC/MS analyses is a powerful and cost-effective analytical tool that can be particularly effective in assessing locations with suspect disposal practices, complex or uncertain site history, and/or sites that require detailed evaluation of critical exposure pathways. When GC/MS analytical methods are utilized in support of MCP decision-making, an analysis of TICs is:

Not usually expected at petroleum-only sites,
Not usually expected when the contaminants of concern have been previously identified,
Not usually expected when used to determine the extent and magnitude of contamination associated with a "known" release of OHM, and/or
Should be considered, at the discretion of the LSP, in support of site characterization activities for releases at locations with complex and/or uncertain history.

It should be noted that TICs only need to be evaluated by the laboratory when specifically requested by the data user. For the WSC-CAM-IX B CAM Protocol, TICs would be an appropriate screening tool for determining potential constiutents of concern.

3.3.1 Reporting of TICs

If evaluated, all TICs that meet the chromatographic criteria presented in Section 1.0 of Appendix IX B-3 must be reported by the laboratory either in the laboratory report or in the laboratory narrative. In turn, the data user must include a discussion regarding the disposition of all reported TICs as part of the MCP submittal. Depending on specific site circumstances (e.g., a potentially toxic contaminant is found in residential indoor air samples, etc.), resampling/re-analysis with analyte-specific calibration and QC may be required to definitively assess the risk posed by the TIC to human health and the environment. Guidance for the evaluation of TICs for MCP decision-making is presented in Appendix IX B-3 of this document.

Appendix IX B-1

Sample Collection, Preservation, and Handling Procedures for VOC Analyses in Air

Sample preservation, container and analytical holding time specifications for air matrices for VOCs analyzed in support of MCP decision-making are summarized below and presented in Appendix VII A-1 of WSC-CAM-VII A, *Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data Conducted in Support of Response Actions Conducted Under the Massachusetts Contingency Plan (MCP)*.

Matrix	Container[1]	Preservation	Holding Time[2,3]
Air	Certified clean, leak-free, stainless steel polished or silica lined passivated air sampling canisters	None	30 days

[1]The size of the canister will depend on project requirements.

[2]Holding time begins from time of sample collection.

[3]As per Appendix IV of MassDEP Policy #WSC-07-350, *MCP Representativeness Evaluations and Data Usability Assessments*, September 2007, if the holding time is exceeded by >2x the allowable holding time, data users should consider nondetect results as unusable and positive results as estimated with a significantly low bias.

Appendix IX B-2

Data Deliverable Requirements for Data Audits

If requested by MassDEP, submission of the information listed below may be required to perform a data audit to verify compliance with the analytical methods and to evaluate accuracy and reliability of the reported results. These deliverables represent a "full data package" including all sample documentation from receipt through preparation, analysis, and data reporting. The laboratory must ensure that these deliverables are available, in the event a data audit is performed. The laboratory is required to retain these deliverables for a period of 10 years from the date generated.

DELIVERABLE REQUIREMENTS FOR DATA AUDITS WSC-CAM-IX B (EPA TO-15)	
Laboratory Narrative	Must comply with the required laboratory narrative contents as described in WSC-CAM-VII A
Sample Handling Information	Chains-of-custody (external and internal), sample receipt logs, correspondences
Miscellaneous Logs	Canister pressure logs Injection logs Flow controller calibration logs
Initial Calibration Data	Summary of response factors for all standards in initial calibration; average response factors, %RSDs, correlation coefficients, and coefficients of determination for all target compounds Chromatograms for all standards used in initial calibration Quantitation reports for all standards used in initial calibration Concentrations of standards used must be clearly presented
Continuing Calibration Data	Summary of %Ds and response factors Chromatograms for all continuing calibration standards Quantitation reports for all continuing calibration standards Concentrations of standards used must be clearly presented
Sample Results	Chromatograms for all sample analyses, reanalyses, and dilutions Quantitation reports for all sample analyses, reanalyses, and dilutions Mass spectra of reported positive results Summary of results, including reporting limits for each sample Date of analysis

DELIVERABLE REQUIREMENTS FOR DATA AUDITS WSC-CAM-IX B (EPA TO-15)	
Method Blank Results	Chromatograms for all method blanks Quantitation reports for all method blanks Summary of results, including reporting limits Mass spectra of positive results in method blanks
LCS Results	Chromatograms for all LCSs Quantitation reports for all LCSs Summary of results, including concentrations detected, concentrations spiked, and percent recoveries
Matrix Duplicate Results (if performed)	Chromatograms for all matrix duplicates Quantitation reports for all matrix duplicates Summary of results, including original sample concentrations, matrix duplicate concentrations and RPDs
GC/MS Tune Data	BFB tune raw data: chromatogram, mass listing of BFB, and summary of tune results
QC Summaries	Internal standard performance
Other Information	Demonstration that LCS prepared from second source standard
Quantitation reports must exhibit area counts of target compounds, internal standards, and surrogates.	

Appendix IX B-3

Guidance for Evaluation of Tentatively Identified Compounds (TICs) for WSC-CAM-IX B under the MCP

A logic diagram for the Evaluation of Tentatively Identified Compounds (TICs) for WSC-CAM-IX B under the MCP is presented in Exhibit IX B-1. This exhibit graphically presents a systematic approach to evaluate TICs based on chromatographic, mass spectral, and toxic spectral characteristics criteria.

1.0 Specific Criteria for the Evaluation of TICs

1.1 Chromatographic Criteria

- Initially include all of the non-target compounds that have a peak area count of $\geq$ 10% of the nearest internal standard.

1.2 Mass Spectral Criteria

- All spectra must be evaluated by a qualified mass spectrometrist.
- The spectral library match must be $\geq$ 85% for a tentative identification to be made.
- The major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within $\pm$ 20%.
- Molecular ions present in the reference spectrum should be present in the sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or for the presence of co-eluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks.
- Structural isomers that produce very similar mass spectra can be explicitly identified only if they have sufficiently different chromatographic retention times. Acceptable resolution is achieved if the height of the valley between two peaks is less than 25% of the average height of the two peaks. Otherwise, structural isomers are identified as isomeric pairs (as a mixture of two isomers).
- Spectra identified as “unknown” should be assigned to a general chemical class, if possible. Classification as a halogenated hydrocarbon, aldehyde/ketone, carboxylic acid, or cyano compound, etc. is acceptable. An explanation as to why more specific identification cannot be made (e.g., truncated spectra due to insufficient mass scanning range) must be provided in the laboratory narrative to support any “unknown” classification.
- TICs, which are identified as petroleum aliphatic hydrocarbons, do not have to be reported as TICs. However, there must be a statement in the laboratory narrative discussing the presence of these hydrocarbons in the sample(s).

After the above criteria are met, the top ten (10) compounds, chosen by comparing the area of the TIC to the area of the nearest internal standard, must be tentatively identified, quantitated, and reported.

1.3 Toxic Spectral Characteristics Criteria

Regardless of the peak area count in relation to the nearest internal standard, the laboratory must evaluate the spectra for any compound if the mass spectrum:

- Exhibits a characteristic chlorine or bromine spectral pattern.

2.0 Reporting Criteria

All TICs must be reported by the laboratory with the clear indication that the reported concentration is an estimated value unless analyte-specific calibration and QC were performed as discussed in Section 3.3.1 of the CAM Protocol. This reporting requirement may be fulfilled by discussion in the laboratory narrative, or by some other laboratory reporting convention to qualify the sample results. General laboratory reporting requirements are presented in WSC-CAM-VII A, Section 2.4.

If a data user determines that the presence of the TIC at the estimated concentration reported by the laboratory may appreciably increase the overall risk posed by the site or the utility/cost of the potential remedial measures under consideration, additional analytical work is recommended to verify the identification and/or concentration of the reported TIC either by reanalysis or resampling. This contingency will require additional coordination and communication between the laboratory and the data user.

Exhibit IX B-1