Kansas City PM Characterization Study
Final Report

Appendix CC
Scope of Work

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Sponsors:

National Renewable Energy Laboratory, U.S. Department of Energy
Federal Highway Administration, U.S. Department of Transportation
STAPPA-ALAPCO Emission Inventory Improvement Program
Coordinating Research Council Inc. (Project No. E-69)

Prepared for EPA by
Eastern Research Group, Incorporated
Austin, TX

Bevilacqua-Knight Incorporated
Oakland, CA

NuStats LLC
Austin, TX

Desert Research Institute
Reno, NV

EPA Contract No. GS 10F-0036K

October 27,2006
Revised April 2008 by EPA staff

United States
Environmental Protection
Agency

EPA420-R-08-009
April 2008

ORDER FOR SUPPLIES OR SERVICES

PAGE OF PAGES

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

1.DATE OF ORDER	
2. CONTRACT NO. *(If any)*	GS-10F-0036K
3. ORDER NO.	1104
4.REQUISITION/REFERENCE NO.	PR-CI-04-10377
5. ISSUING OFFICE *(Address correspondence to)*	Environmental Protection Agency
7. TO:	
a. NAME OF CONTRACTOR	EASTERN RESEARCH GROUP INC
b. COMPANY NAME	
c. STREET ADDRESS	110 HARTWELL AVENUE
d. CITY	Lexington
e. STATE	MA
f. ZIP CODE	02421

6. SHIP TO:

a. NAME OF CONSIGNEE	KATHLEEN A. WALSH, TOPO	
b. STREET ADDRESS	2565 PLYMOUTH ROAD	
c. CITY	ANN ARBOR	
d. STATE	MI	
e. ZIP CODE	48105	
f. SHIP VIA		

8. TYPE OF ORDER

[ ] a. PURCHASE REFERENCE YOUR: _____

Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet. If any, including delivery as indicated.

[X] b.TASK -- Except for billing instructions on the reverse, this task order is subject to instructions contained on this side only of this form and is issued subject to the terms and contitions of the above-numbered contract.

9. ACCOUNTING AND APPROPRIATION DATA	See Attached
10. REQUISITIONING OFFICE	Same as Block 6

11. BUSINESS CLASSIFICATION (Check appropriate box(es))

[ ] a. SMALL [X] b. OTHER THAN SMALL [ ] c. DISADVANTAGED [ ] d. WOMEN OWNED

12. F.O.B. POINT	13. PLACE OF a. INSPECTION	13. PLACE OF b. ACCEPTANCE	14. GOVERNMENT B/L NO.	15. DELIVER TO F.O.B. POINT ON OR BEFORE *(Date)*	16. DISCOUNT TERMS
Same as Block 6					N/A

17. SCHEDULE *(See reverse for Rejections)*

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	See Attached All Base CLINs as set forth in Attachment 7 are ordered at time of award.					

SEE BILLING INSTRUCTIONS ON REVERSE	18. SHIPPING POINT	19. GROSS SHIPPING WEIGHT	20. INVOICE NO.	17(h). TOT. *(Cont. pages)*
	21. MAIL INVOICE TO:			
	a. NAME			
	b. STREET ADDRESS (or P.O. Box)			
	c. CITY	d. STATE	e. ZIP CODE	$543,223.96 — 17(i). GRAND TOTAL

22. UNITED STATES OF AMERICA BY *(Signature)* ▶ See Page 2

23. NAME *(Typed)*

DAVID H. PLAGGE

TITLE: CONTRACTING/ORDERING OFFICER

Task Order Signature Sheet

CONTRACTOR

EASTERN RESEARCH GROUP INC

By: _____ _____
Date Signed

Title: _____

ENVIRONMENTAL PROTECTION AGENCY

By: _____ _____
Date Signed

Title: Contracting Officer

Characterizing Exhaust Emissions from Light Duty Gasoline Vehicles in the Kansas City Metropolitan Area

Contract: GS-10F-0036K, Task Order: 1104 Lead PR Number: PR-CI-04-10377

Summary Information

Title: Characterizing Exhaust Emissions from Light Duty Gasoline Vehicles in the Kansas City Metropolitan Area
Period of Performance: From: Effective of Task Order
To: 08/15/05

Award Date:
Total Funding: $543,223.96

Accounting/Appropriation Data

POP	DCN	BFYS	Appr.#	Org	Program Element	Site/ Project	Cost Org	Obj Clss	Amount	P/C
Base	H30421	03	CR1	56H5X04	10102A	00000000	2505		$255,000.00	C
Base	U2C172	03	C	26U20NN	10201F	00000000	2532		$88,223.96	P
Base	H30385	03	CR	56H0X03	10101A	00000000	2505		$200,000.00	C

Funding Breakout

Acct.Info	Funding Category	Amount
FY2003 - H30385	Cost Ceiling	$200,000.00
	Total:	$200,000.00
FY2003 - H30421	Cost Ceiling	$255,000.00
	Total:	$255,000.00
FY2003 - U2C172	Cost Ceiling	$88,223.96
	Total:	$88,223.96

Procurement Management Roles

TASK ORDER PROJECT OFFICER:

U.S. E.P.A.
Attn: KATHLEEN A. WALSH
2565 PLYMOUTH ROAD
ANN ARBOR, MI 48105

Mail Code:
Phone Number:
Fax Number:
E-Mail Address:

ALTERNATE TASK ORDER PROJECT OFFICER:

U.S. E.P.A.
Attn: RICHARD W. BALDAUF
RESEARCH TRIANGLE PARK
RTP, NC 27711

Mail Code:
Phone Number:
Fax Number:
E-Mail Address:

ALTERNATE TASK ORDER PROJECT OFFICER:

U.S. E.P.A.
Attn: CARL R. FULPER
2565 PLYMOUTH ROAD
ANN ARBOR, MI 48105

Mail Code:
Phone Number:
Fax Number:
E-Mail Address:

Attachments

Attachment Name
Applicable EPA Clauses
Performance Work Statement
Appendix A
Appendix B
Appendix C
Appendix D
Task Order Line Items
Incentive Plan

Task Order Totals

Category	POP	Amount
Cost Ceiling	Base Pd.	$3,894,463.84

COMPLIANCE WITH EPA POLICIES FOR INFORMATION RESOURCES MANAGEMENT (EPAAR 1552.211-79) (OCT 2000)

(a) Definition. Information Resources Management (IRM) is defined as any planning, budgeting, organizing, directing, training, promoting, controlling, and managing activities associated with the burden, collection, creation, use and dissemination of information. IRM includes both information itself, and the management of information and related resources such as personnel, equipment, funds, and technology. Examples of these services include but are not limited to the following:

(1) The acquisition, creation, or modification of a computer program or automated data base for delivery to EPA or use by EPA or contractors operating EPA programs.

(2) The analysis of requirements for, study of the feasibility of, evaluation of alternatives for, or design and development of a computer program or automated data base for use by EPA or contractors operating EPA programs.

(3) Services that provide EPA personnel access to or use of computer or word processing equipment, software, or related services.

(4) Services that provide EPA personnel access to or use of: Data communications; electronic messaging services or capabilities; electronic bulletin boards, or other forms of electronic information dissemination; electronic record-keeping; or any other automated information services.

(b) *General*. The Contractor shall perform any IRM related work under this contract in accordance with the IRM policies, standards and procedures set forth in this clause and noted below. Upon receipt of a work request (i.e. delivery order or work assignment), the Contractor shall check this listing of directives (see paragraph (d) for electronic access). The applicable directives for performance of the work request are those in effect on the date of issuance of the work request.

(1) IRM Policies, Standards and Procedures. The 2100 Series (2100-2199) of the Agency's Directive System contains the majority of the Agency's IRM policies, standards and procedures.

(2) Groundwater Program IRM Requirement. A contractor performing any work related to collecting Groundwater data; or developing or enhancing data bases containing Groundwater quality data shall comply with *EPA Order 7500.1A - Minimum Set of Data Elements for Groundwater*.

(3) EPA Computing and Telecommunications Services. *The Enterprise Technology Services Division (ETSD) Operational Directives Manual* contains procedural information about the operation of the Agency's computing and telecommunications services. Contractors performing work for the Agency's National Computer Center or those who are developing systems which will be operating on the Agency's national platforms must comply with procedures established in the Manual. (This document may be found at: http://basin.rtpnc.epa.gov:9876/etsd/directives.nsf.)

(c) *Printed Documents*. Documents listed in (b)(1) and (b)(2) may be obtained from:

U.S. Environmental Protection Agency
Office of Administration
Facilities Management and Services Division
Distribution Section
Mail Code: 3204
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460
Phone: (202) 260-5797

(d) *Electronic Access*. Electronic access. A complete listing, including full text, of documents included in the 2100 Series of the Agency's Directive System is maintained on the EPA Public Access Server on the Internet at http://epa.gov/docs/irmpoli8/.

INSPECTION AND ACCEPTANCE (EP 52.246-100) (APR 1984)

(a) The Contracting Officer or the duly authorized representative will perform inspection and acceptance of materials and services to be provided.

(b) For the purposes of this clause, the Project Officer is the authorized representative of the Contracting Officer.

(c) Inspection and acceptance will be performed at:

U.S. EPA NVFEL
2565 Plymouth Rd.
Ann Arbor, MI 48108

PERIOD OF PERFORMANCE (EP 52.212-140) (APR 1984)

The period of performance of this contract shall be from AWARD DATE through August 15, 2005 inclusive of all required reports.

CONTRACT ADMINISTRATION REPRESENTATIVES (EP 52.242-100) (AUG 1984)

Project Officer(s) for this contract:

Project Officer:
Kitty Walsh
US EPA NVFEL, Stop ASD
2565 Plymouth Road
Ann Arbor MI 48105

Telephone: (734) 214-4228
Fax: (734) 214-4816

Alternate Project Officer:
Carl Fulper
US EPA NVFEL, Stop ASD
2565 Plymouth Road
Ann Arbor MI 48105

Telephone: (734) 214-4400
Fax: (734) 214-4816

Alternate Project Officer:
Rich Baldauf - Stop MD-E205-04
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

Telephone: (919) 541-4386
Fax: (919) 541-0960

Contract Specialist(s) responsible for administering this contract:

Matt Growney
26 W. Martin Luther King Drive
Cincinnati OH 45268
Telephone (513)487-2029
Fax: (513) 487-2107

Administrative Contracting Officer:

David Plagge
26 W. Martin Luther King Drive
Cincinnati OH 45268
Telephone (513)487-2022
Fax: (513) 487-2107

ORGANIZATIONAL CONFLICTS OF INTEREST (EPAAR 1552.209-71) (MAY 1994) ALTERNATE I (MAY 1994)

(a) The Contractor warrants that, to the best of the Contractor's knowledge and belief, there are no relevant facts or circumstances which could give rise to an organizational conflict of interest, as defined in FAR Subpart 9.5, or that the Contractor has disclosed all such relevant information.

(b) Prior to commencement of any work, the Contractor agrees to notify the Contracting Officer immediately that, to the best of its knowledge and belief, no actual or potential conflict of interest exists or to identify to the Contracting Officer any actual or potential conflict of interest the firm may have. In emergency situations, however, work may begin but notification shall be made within five (5) working days.

(c) The Contractor agrees that if an actual or potential organizational conflict of interest is identified during performance, the Contractor will immediately make a full disclosure in writing to the Contracting Officer. This disclosure shall include a description of actions which the Contractor has taken or proposes to take, after consultation with the Contracting Officer, to avoid, mitigate, or neutralize the actual or potential conflict of interest. The Contractor shall continue performance until notified by the Contracting Officer of any contrary action to be taken.

(d) Remedies - The EPA may terminate this contract for convenience, in whole or in part, if it deems such termination necessary to avoid an organizational conflict of interest. If the Contractor was aware of a potential organizational conflict of interest prior to award or discovered an actual or potential conflict after award and did not disclose it or misrepresented relevant information to the Contracting Officer, the Government may terminate the contract for default, debar the Contractor from Government contracting, or pursue such other remedies as may be permitted by law or this contract.

(e) The Contractor agrees to insert in each subcontract or consultant agreement placed hereunder provisions which shall conform substantially to the language of this clause, including this paragraph, unless otherwise authorized by the Contracting Officer.

NOTIFICATION OF CONFLICTS OF INTEREST REGARDING PERSONNEL (EPAAR 1552.209-73) (MAY 1994)

(a) In addition to the requirements of the contract clause entitled "Organizational Conflicts of Interest," the following provisions with regard to employee personnel performing under this contract shall apply until the earlier of the following two dates: the termination date of the affected employee(s) or the expiration date of the contract.

(b) The Contractor agrees to notify immediately the EPA Project Officer and the Contracting Officer of (1) any actual or potential personal conflict of interest with regard to any of its employees working on or having access to information regarding this contract, or (2) any such conflicts concerning subcontractor employees or consultants working on or having access to information regarding this contract, when such conflicts have been reported to the Contractor. A personal conflict of interest is defined as a relationship of an employee, subcontractor employee, or consultant with an entity that may impair the objectivity of the employee, subcontractor employee, or consultant in performing the contract work.

(c) The Contractor agrees to notify each Project Officer and Contracting Officer prior to incurring costs for that employee's work when an employee may have a personal conflict of interest. In the event that the personal conflict of interest does not become known until after performance on the contract begins, the Contractor shall immediately notify the Contracting Officer of the personal conflict of interest. The Contractor shall continue performance of this contract until notified by the Contracting Officer of the appropriate action to be taken.

(d) The Contractor agrees to insert in any subcontract or consultant agreement placed hereunder, except for subcontracts or consultant agreements for well drilling, fence erecting, plumbing, utility hookups, security guard services, or electrical services, provisions which shall conform substantially to the language of this clause, including this paragraph (d), unless otherwise authorized by the Contracting Officer.

SCREENING BUSINESS INFORMATION FOR CLAIMS OF CONFIDENTIALITY (EPAAR 1552.235-70) (APR 1984)

(a) Whenever collecting information under this contract, the Contractor agrees to comply with the following requirements:

(1) If the Contractor collects information from public sources, such as books, reports, journals, periodicals, public records, or other sources that are available to the public without restriction, the Contractor shall submit a list of these sources to the appropriate program office at the time the information is initially submitted to EPA. The Contractor shall identify the information according to source.

(2) If the Contractor collects information from a State or local Government or from a Federal agency, the Contractor shall submit a list of these sources to the appropriate program office at the time the information is initially submitted to EPA. The Contractor shall identify the information according to source.

(3) If the Contractor collects information directly from a business or from a source that represents a business or businesses, such as a trade association:

(i) Before asking for the information, the Contractor shall identify itself, explain that it is performing contractual work for the Environmental Protection Agency, identify the information that it is seeking to collect, explain what will be done with the information, and give the following notice:

(A) You may, if you desire, assert a business confidentiality claim covering part or all of the information. If you do assert a claim, the information will be disclosed by EPA only to the extent, and by means of the procedures, set forth in 40 CFR Part 2, Subpart B.

(B) If no such claim is made at the time this information is received by the Contractor, it may be made available to the public by the Environmental Protection Agency without further notice to you.

(C) The Contractor shall, in accordance with FAR Part 9, execute a written agreement regarding the limitations of the use of this information and forward a copy of the agreement to the Contracting Officer.

(ii) Upon receiving the information, the Contractor shall make a written notation that the notice set out above was given to the source, by whom, in what form, and on what date.

(iii) At the time the Contractor initially submits the information to the appropriate program office, the Contractor shall submit a list of these sources, identify the information according to source, and indicate whether the source made any confidentiality claim and the nature and extent of the claim.

(b) The Contractor shall keep all information collected from nonpublic sources confidential in accordance with the clause in this contract entitled "Treatment of Confidential Business Information" as if it had been furnished to the Contractor by EPA.

(c) The Contractor agrees to obtain the written consent of the Contracting Officer, after a written determination by the appropriate program office, prior to entering into any subcontract that will require the subcontractor to collect information. The Contractor agrees to include this clause, including this paragraph (c), and the clause entitled "Treatment of Confidential Business Information" in all subcontracts awarded pursuant to this contract that require the subcontractor to collect information.

TREATMENT OF CONFIDENTIAL BUSINESS INFORMATION (EPAAR 1552.235-71) (APR 1984)

(a) The Contracting Officer, after a written determination by the appropriate program office, may disclose confidential business information (CBI) to the Contractor necessary to carry out the work required under this contract. The Contractor agrees to use the CBI only under the following conditions:

(1) The Contractor and Contractor's employees shall: (i) use the CBI only for the purposes of carrying out the work required by the contract; (ii) not disclose the information to anyone other than properly cleared EPA employees without the prior written approval of the Assistant General Counsel for Contracts and Information Law; and (iii) return to the Contracting Officer all copies of the information, and any abstracts or excerpts therefrom, upon request by the Contracting Officer, whenever the information is no longer required by the Contractor for the performance of the work required by the contract, or upon completion of the contract.

(2) The Contractor shall obtain a written agreement to honor the above limitations from each of the Contractor's employees who will have access to the information before the employee is allowed access.

(3) The Contractor agrees that these contract conditions concerning the use and disclosure of CBI are included for the benefit of, and shall be enforceable by, both EPA and any affected businesses having a proprietary interest in the information.

(4) The Contractor shall not use any CBI supplied by EPA or obtained during performance hereunder to compete with any business to which the CBI relates.

(b) The Contractor agrees to obtain the written consent of the CO, after a written determination by the appropriate program office, prior to entering into any subcontract that will involve the disclosure of CBI by the Contractor to the subcontractor. The Contractor agrees to include this clause, including this paragraph (b), in all subcontracts awarded pursuant to this contract that require the furnishing of CBI to the subcontractor.

RELEASE OF CONTRACTOR CONFIDENTIAL BUSINESS INFORMATION (EPAAR 1552.235-79) (APR 1996)

(a) The Environmental Protection Agency (EPA) may find it necessary to release information submitted by the Contractor either in response to this solicitation or pursuant to the provisions of this contract, to individuals not employed by EPA. Business information that is ordinarily entitled to confidential treatment under existing Agency regulations (40 C.F.R. Part 2) may be included in the information released to these individuals. Accordingly, by submission of this proposal or signature on this contract or other contracts, the Contractor hereby consents to a limited release of its confidential business information (CBI).

(b) Possible circumstances where the Agency may release the Contractor's CBI include, but are not limited to the following:

(1) To other Agency contractors tasked with assisting the Agency in the recovery of Federal funds expended pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. Sec. 9607, as amended, (CERCLA or Superfund);

(2) To the U.S. Department of Justice (DOJ) and contractors employed by DOJ for use in advising the Agency and representing the Agency in procedures for the recovery of Superfund expenditures;

(3) To parties liable, or potentially liable, for costs under CERCLA Sec. 107 (42 U.S.C. Sec. 9607), et al, and their insurers (Potentially Responsible Parties) for purposes of facilitating settlement or litigation of claims against such parties;

(4) To other Agency contractors who, for purposes of performing the work required under the respective contracts, require access to information the Agency obtained under the Clean Air Act (42 U.S.C. 7401 et seq.); the Federal Water Pollution Control Act (33 U.S.C.1251 et seq.); the Safe Drinking Water Act (42 U.S.C. 300f et seq.); the Federal Insecticide, Fungicide and Rodenticide Act (7 U.S.C. 136 et seq.); the Resource

Conservation and Recovery Act (42 U.S.C. 6901 et seq.); the Toxic Substances Control Act (15 U.S.C. 2601 et seq.); or the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 et seq.);

(5) To other Agency contractors tasked with assisting the Agency in handling and processing information and documents in the administration of Agency contracts, such as providing both preaward and post award audit support and specialized technical support to the Agency's technical evaluation panels;

(6) To employees of grantees working at EPA under the Senior Environmental Employment (SEE) Program;

(7) To Speaker of the House, President of the Senate, or Chairman of a Committee or Subcommittee;

(8) To entities such as the General Accounting Office, boards of contract appeals, and the Courts in the resolution of solicitation or contract protests and disputes;

(9) To Agency contractor employees engaged in information systems analysis, development, operation, and maintenance, including performing data processing and management functions for the Agency; and

(10) Pursuant to a court order or court-supervised agreement.

(c) The Agency recognizes an obligation to protect the contractor from competitive harm that may result from the release of such information to a competitor. (See also the clauses in this document entitled "Screening Business Information for Claims of Confidentiality" and "Treatment of Confidential Business Information.") Except where otherwise provided by law, the Agency will permit the release of CBI under subparagraphs (1), (3), (4), (5), (6), or (9) only pursuant to a confidentiality agreement.

(d) With respect to contractors, 1552.235-71 will be used as the confidentiality agreement. With respect to Potentially Responsible Parties, such confidentiality agreements may permit further disclosure to other entities where necessary to further settlement or litigation of claims under CERCLA. Such entities include, but are not limited to accounting firms and technical experts able to analyze the information, provided that they also agree to be bound by an appropriate confidentiality agreement.

(e) This clause does not authorize the Agency to release the Contractor's CBI to the public pursuant to a request filed under the Freedom of Information Act.

(f) The Contractor agrees to include this clause, including this paragraph (f), in all subcontracts at all levels awarded pursuant to this contract that require the furnishing of confidential business information by the subcontractor.

KEY PERSONNEL (EPAAR 1552.237-72) (APR 1984)

(a) The Contractor shall assign to this contract the following key personnel:

PROJECT MANAGER - Sandeep Kishan

(b) During the first ninety (90) calendar days of performance, the Contractor shall make no substitutions of key personnel unless the substitution is necessitated by illness, death, or termination of employment. The Contractor shall notify the Contracting Officer within 15 calendar days after the occurrence of any of these events and provide the information required by paragraph (c) below. After the initial ninety (90) calendar day period, the Contractor shall submit the information required by paragraph (c) to the Contracting Officer at least 15 calendar days prior to making any permanent substitutions.

(c) The Contractor shall provide a detailed explanation of the circumstances necessitating the proposed substitutions, complete resumes for the proposed substitutes, and any additional information requested by the Contracting Officer. Proposed substitutes should have comparable qualifications to those of the persons being replaced. The Contracting Officer will notify the Contractor within 15 calendar days after receipt of

all required information of the decision on substitutions. This clause will be modified to reflect any approved changes of key personnel.

ORGANIZATIONAL CONFLICT OF INTEREST NOTIFICATION (EPAAR 1552.209-70) (APR 1984)

(a) The prospective Contractor certifies, to the best of its knowledge and belief, that it is not aware of any information bearing on the existence of any potential organizational conflict of interest. If the prospective Contractor cannot so certify, it shall provide a disclosure statement in its proposal which describes all relevant information concerning any past, present, or planned interests bearing on whether it (including its chief executives and directors, or any proposed consultant or subcontractor) may have a potential organizational conflict of interest.

(b) Prospective Contractors should refer to FAR Subpart 9.5 and EPAAR Part 1509 for policies and procedures for avoiding, neutralizing, or mitigating organizational conflicts of interest.

(c) If the Contracting Officer determines that a potential conflict exists, the prospective Contractor shall not receive an award unless the conflict can be avoided or otherwise resolved through the inclusion of a special contract clause or other appropriate means. The terms of any special clause are subject to negotiation.

CONSIDERATION AND PAYMENT--ITEMIZED FIXED PRICES (EP 52.216-170) (APR 1984)

The fixed price of this contract is $543,223.96 (without incentives). Payment will be made upon delivery and acceptance of required items as follows:

Base	Net 30 Days After Completion and Acceptance
Option 1	Net 30 Days After Completion and Acceptance
Option 2	Net 30 Days After Completion and Acceptance
Option 3	Net 30 Days After Completion and Acceptance
Option 4	Net 30 Days After Completion and Acceptance
Option 5	Net 30 Days After Completion and Acceptance

HIGHER-LEVEL CONTRACT QUALITY REQUIREMENT (GOVERNMENT SPECIFICATION) (FAR 52.246-11) (MAR 2001)

The Contractor shall comply with the higher-level quality standard selected below.

	Title	Numbering	Date	Tailoring
[✔]	*Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*	ANSI/ASQC E4	1994	See below
[ ]				
[ ]				

As authorized by FAR 52.246-11, the higher-level quality standard ANSI/ASQC E4 is tailored as follows:

The solicitation and contract require the offeror/contractor to demonstrate conformance to ANSI/ASQC E4 by submitting the quality documentation described below.

In addition, after award of the contract, the Contractor shall revise, when applicable, quality documentation submitted before award to address specific comments provided by EPA and submit the revised documentation to the Contracting Officer's Representative.

After award of the contract, the Contractor shall also implement all quality documentation approved by the Government.

A. **Pre-award Documentation:** The offeror must submit the following quality system documentation as a separate and identifiable part of its technical proposal: *(CO, select one or more)*

	Documentation	Specifications
[X]	Quality Management Plan	EPA Requirements for Quality Management Plans (QA/R-2) [dated 03/20/01]
[ ]	Joint Quality Management Plan/Quality Assurance Project Plan for the contract	EPA Requirements for Quality Management Plans (QA/R-2) [dated 03/20/01] and EPA Requirements for Quality Assurance Project Plans (QA/R) [dated 03/20/01]
[X]	Programmatic Quality Assurance Project Plan for the entire program (contract)	EPA Requirements for Quality Assurance Project Plans (QA/R-5) [dated 03/20/01]
[ ]	Other Equivalent: _____	_____

This documentation will be prepared in accordance with the specifications identified above. Work involving environmental data generation or use shall not commence until the Government has approved this documentation and incorporated it into the contract.

B. **Post-award Documentation:** The Contractor shall submit the following quality system documentation to the Contracting Officer's Representative at the time frames identified below: *(CO, select one or more)*

	Documentation	Specification	Due After
[ ]	Quality Management Plan	EPA Requirements for Quality Management Plans (QA/R-2) [dated 03/20/01]	Award of contract
[ ]	Joint Quality Management Plan/Quality Assurance Project Plan for the contract	EPA Requirements for Quality Management Plans (QA/R-2) [dated 03/20/01] and EPA Requirements for Quality Assurance Project Plans (QA/R-5) [dated 03/20/02]	Award of contract

[ ]	Quality Assurance Project Plan for the contract	EPA Requirements for Quality Assurance Project Plans (QA/R-5 [dated 03/20/01]	Award of contract
[ ]	Programmatic Quality Assurance Project Plan for the entire program (contract)	EPA Requirements for Quality Assurance Project Plans (QA/R-5 [dated 03/20/01]	Award of contract
[X]	Quality Assurance Project Plan for each applicable project	EPA Requirements for Quality Assurance Project Plans (QA/R-5 [dated 03/20/01]	Exercise of Option for each task order
[ ]	Project-specific supplement to Programmatic Quality Assurance Project Plan for each applicable project.	EPA Requirements for Quality Assurance Project Plans (QA/R-5 [dated 03/20/01]	Issuance of statement of work for the project
[ ]	Other Equivalent: _____	_____	[ ] award of contract [ ] issuance of statement of work for the project

This documentation will be prepared in accordance with the specifications identified above.

The Government will review and return the quality documentation, with comments, and indicating approval or disapproval. If necessary, the contractor shall revise the documentation to address all comments and shall submit the revised documentation to the government for approval.

The Contractor shall not commence work involving environmental data generation or use until the Government has approved the quality documentation.

(Note: Statement of work includes statements of work to perform projects under work assignments, task orders, delivery orders, etc.)

SUBMISSION OF INVOICES (EPAAR 1552.232-70) (JUN 1996) ALTERNATE I (JUN 1996) DEVIATION

In order to be considered properly submitted, an invoice or request for contract financing payment must meet the following contract requirements in addition to the requirements of FAR 32.905:

(a) Unless otherwise specified in the contract, an invoice or request for contract financing payment shall be submitted as an original and five copies. The Contractor shall submit the invoice or request for contract financing payment to the following offices/individuals designated in the contract: the original to the Accounting Operations Office shown in Block 21 on the cover of the contract; two copies to the Project Officer (the Project Officer may direct one of these copies to a separate address); and one copy to the Contracting Officer.

(b) The Contractor shall prepare its invoice or request for contract financing payment on the prescribed Government forms. Standard Forms Number 1034, Public Voucher for

Purchases and Services other than Personal, shall be used by contractors to show the amount claimed for reimbursement. Standard Form 1035, Public Voucher for Purchases and Services other than Personal - Continuation Sheet, shall be used to furnish the necessary supporting detail or additional information required by the Contracting Officer. The Contractor may submit self-designed forms which contain the required information.

(c)(1) The Contractor shall prepare a contract level invoice or request for contract financing payment in accordance with the invoice preparation instructions identified as a separate attachment in Section J of the contract. If contract work is authorized by individual delivery orders, the invoice or request for contract financing payment shall also include a summary of the current and cumulative amounts claimed by cost element for each delivery order and for the contract total, as well as any supporting data for each delivery order as identified in the instructions.

(2) The invoice or request for contract financing payment that employs a fixed rate feature shall include current and cumulative charges by contract labor category and by other major cost elements such as travel, equipment, and other direct costs. For current costs, each cost element shall include the appropriate supporting schedules identified in the invoice preparation instructions.

(3) The charges for subcontracts shall be further detailed in a supporting schedule showing the major cost elements for each subcontract. The degree of detail for any subcontract exceeding $5,000 is to be the same as that set forth under (c)(2).

(4) The charges for consultants shall be further detailed in the supporting schedule showing the major cost elements of each consultant. For current costs, each major cost element of the consulting agreement shall also include the supporting schedule identified in the invoice preparation instructions.

(d) Invoices or requests for contract financing payment must clearly indicate the period of performance for which payment is requested. Separate invoices or requests for contract financing payment are required for charges applicable to the basic contract and each option period.

(e)(1) Notwithstanding the provisions of the clause of this contract at FAR 52.216-7, Allowable Cost and Payment, invoices or requests for contract financing payment shall be submitted once per month unless there has been a demonstrated need and Contracting Officer approval for more frequent billings. When submitted on a monthly basis, the period covered by invoices or requests for contractor financing payments shall be the same as the period for monthly progress reports required under this contract.

(2) If the Contracting Officer allows submissions more frequently than monthly, one submittal each month shall have the same ending period of performance as the monthly progress report.

(3) Where cumulative amounts on the monthly progress report differ from the aggregate amounts claimed in the invoice(s) or request(s) for contract financing payments covering the same period, the contractor shall provide a reconciliation of the difference as part of the payment request.

OPTION FOR INCREASED QUANTITY--FIXED-PRICE CONTRACT (EP 52.217-982) (APR 1984)

(a) The Government may increase the quantity of work called for under this contract as follows:

Option	Description	Total Price	Delivery Date
1	Phase 2 Round 1 Vehicle Testing	$1,452,282.59	See PWS
2	Phase 2 Round 1 Speciation Toxic Analysis	$50,923.54	See PWS

3	Phase 3 Round 2 Vehicle Testing	$1,600,871.64	See PWS
4	Phase 3 Round 2 Speciation Toxic Analysis	$55,161.01	See PWS
5	Final Report / Analysis	$148,139.49	See PWS

Please see the Task Order Line Item Attachment for breakout of individual line items prices. The Delivery Schedule s set forth in the Performance Work Statement for the Task Order.

(b) The Contracting Officer may exercise an option by written notice to the Contractor within the following time periods:

Option	Time Period for Exercising Option
1	Up to Twelve (12) Months After Award
2	Up to Twelve (12) Months After Award
3	Up to Twelve (12) Months After Award
4	Up to Twelve (12) Months After Award
5	Up to Twelve (12) Months After Award

Characterizing Exhaust Emissions from Light-Duty Gasoline Vehicles in the Kansas City Metropolitan Area

1.0 EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA), the Coordinating Research Council (CRC), the U.S. Department of Energy's (DOE) National Renewable Energy Lab (NREL), the U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA), and the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) propose to conduct a program to evaluate exhaust emissions from light-duty gasoline vehicles. The proposed program consists of measuring particulate matter (PM) and other components in exhaust emissions of 480 randomly selected, light-duty vehicles in the Kansas City Metropolitan Area. A sampling plan has been developed that will allow for the determination of the distribution of particulate matter (PM) and other emissions in the sampled fleet as well as the identification of the percent of high emitters. Data obtained from this program will be used to evaluate and update existing and future mobile source emission models (MOBILE6 and MOVES), evaluate existing emission inventories and assess the representativeness of previous PM emissions studies.

2.0 BACKGROUND

Mobile sources significantly contribute to ambient concentrations of air contaminants, including particulate matter. Recent source apportionment studies for PM_{10} and $PM_{2.5}$ indicate that mobile sources can be responsible for over half of the ambient PM measured in an urban area (Motallebi, 1999; Magliano, 1998; Dzubay et al., 1988). Some of these source apportionment studies have attempted to differentiate between contributions from gasoline and diesel combustion. Studies conducted in Denver and Phoenix indicated that gasoline combustion from mobile sources contributed more to ambient PM than diesel combustion (Lawson and Smith, 1998; Ramadan, 2000). However, studies conducted in Los Angeles and the San Joaquin Valley in California indicate that diesel combustion contributed more than gasoline combustion to ambient PM (Schauer et al., 1996; Schauer and Cass, 2000). Existing emission inventories developed by the EPA also suggest diesel vehicles contribute more than gasoline vehicles to ambient PM concentrations.

Exhaust emissions of particulate matter from gasoline-powered motor vehicles have changed significantly over the past 25 years (Cadle et al., 1999). These changes have resulted from reformulation of fuels, the wide application of exhaust gas treatment, and changes in engine design and operation. Because of these evolving tailpipe emissions, along with the wide variability of emissions between vehicles of the same class (Hildemann et al., 1991; Cadle et al., 1997; Sagebiel et al., 1997; Yanowitz et al., 2000), well-defined average emissions profiles for the major classes of motor vehicles have not been established.

The majority of exhaust PM emitted by motor vehicles is in the $PM_{2.5}$ size range. Kleeman et al., (2000) have shown that gasoline and diesel fueled vehicles produce particles that are mostly less than 2.0 μm in diameter. Cadle et al., (1999) found that 91% of PM emitted by in-use gasoline vehicles in the Denver area was in the $PM_{2.5}$ size range, which increased to 97% for "smokers" (i.e., light-duty vehicles with visible smoke emitted from their tailpipes). Durbin et al.,(1999) found that 92% of the PM was smaller than 2.5 μm for smokers. The mass median diameter of the PM emitted by the gasoline vehicles sampled by Cadle et al., (1999) was about 0.12 μm, which increased to 0.18 μm for smokers. Corresponding average emissions rates of $PM_{2.5}$ were 38 mg/mi for normal emitting gasoline vehicles and 222 mg/mi for gasoline smokers.

Emissions from smokers are comparable to those from diesel vehicles. Thus, older and poorly maintained gasoline vehicles could be significant sources of $PM_{2.5}$ (Sagebiel et al., 1997; Lawson and Smith, 1998). Durbin et al. (1999) point out that although smokers constitute only 1.1 to 1.7% of the light-duty fleet in the South Coast Air Quality Management District in California, they contribute roughly 20% of the total PM emissions from the light-duty fleet. Motor vehicles that are high emitters of hydrocarbons and carbon monoxide can be high emitters of PM (Sagebiel et al., 1997; Cadle et al., 1997). National distributions of smokers and high emitting vehicles for PM have not been evaluated.

A major obstacle in previous emissions testing studies has been the recruitment of vehicles. Most studies have not incorporated random sampling in the study design due to the high non-participation rate and the high incentive costs associated with random sampling of vehicles. Therefore, few studies, and no studies evaluating light-duty PM emissions, can be used to represent the distribution of vehicle emissions in a large

population.

The EPA, CRC, NREL, DOT, and the STAPPA/ALAPCO and EPA Emission Inventory Improvement Program (EIIP), hereafter referred to as the Project "Sponsors", plan to conduct a program to characterize exhaust emissions from light-duty gasoline vehicles. Data obtained from this program will be used to evaluate and update existing and future mobile source emission models (MOBILE6 and MOVES) and evaluate existing emission inventories. For the purpose of this RFP, the term "Contractor" shall include the primary contractor and any subcontractors awarded the project task order.

3.0 PROJECT DESCRIPTION

The Sponsors propose to conduct exhaust emissions testing on 480 light-duty, gasoline vehicles in the Kansas City Metropolitan Area (KCMA). The goal of the project is to determine the distribution of PM emissions in a randomly selected fleet as well as identify the percent of high emitters in the fleet. The project will also characterize gaseous and PM toxics exhaust emissions from a portion of these light-duty vehicles. Data obtained from this program will be used to evaluate and update emission models, evaluate existing emission inventories, and assess the representativeness of previous emissions studies.

EPA through its Project Officer will represent the Sponsors during this test program. The contractor will address and forward all issues and technical assistance through EPA Project Officer. The Project Officer will disseminate this information to the Sponsors to get the best advice on how to proceed. The information from the contractor can be sent to the Sponsors and the EPA Project Officer at the same time but only the Project Officer can give technical guidance to the contractor. The EPA Project Officer will assume the responsibility that all Sponsors are provided the information in a timely fashion. The Sponsors will assure that they or their representative give timely advice back to the Project Officer in order to keep delays to a minimum.

The EPA Project Officer, or any representatives of the project sponsors, will conduct audits of all facets of the project. The contractor may be notified prior to an audit; however, the sponsors reserve the right to conduct audits without notification.

The project description has been divided into three main sections: Vehicle Recruitment and Pilot Studies, Vehicle Testing, and Sample Analysis. The contractor shall ensure integration of all three work areas. Specific tasks associated with each of these work areas are listed in Section 5.

3.1 Vehicle Recruitment

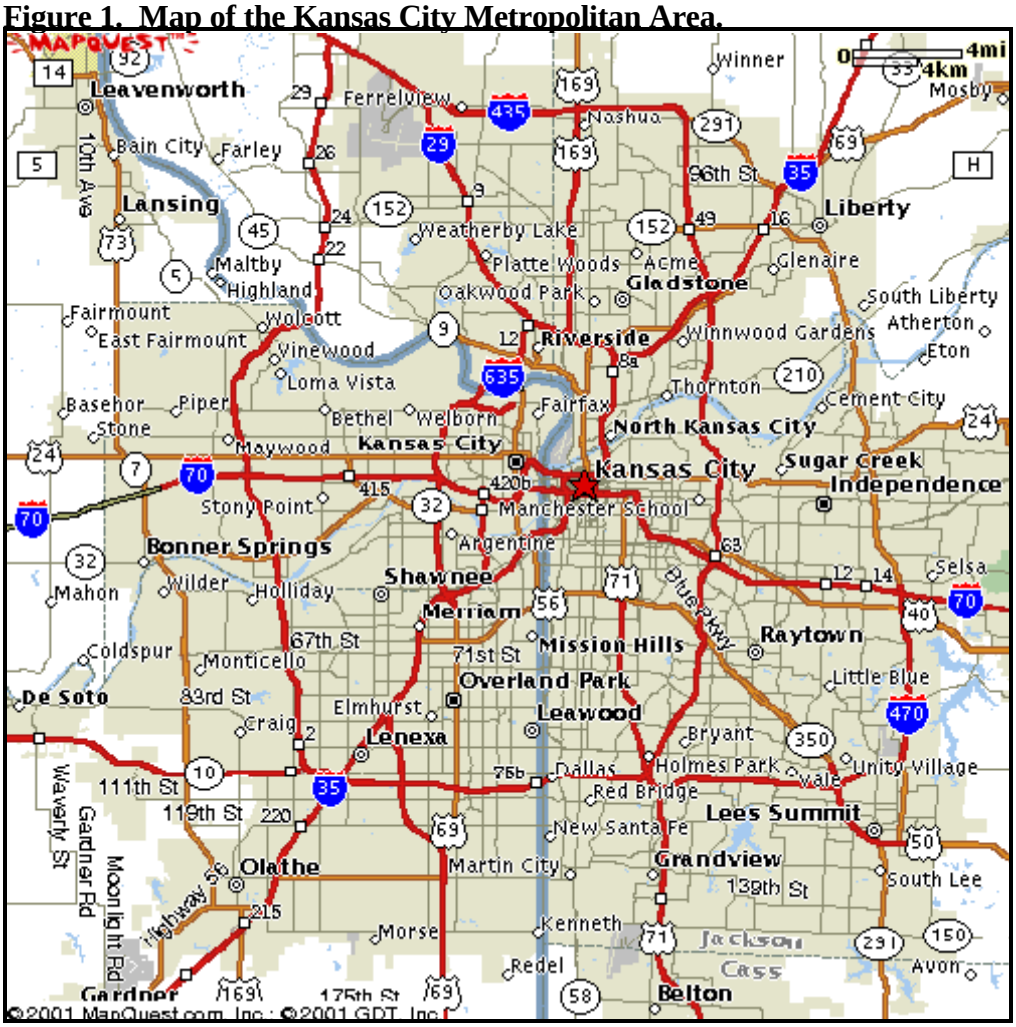
Vehicle recruitment activities will be designed to identify the distribution of PM emissions from gasoline vehicles in order to better evaluate the contribution of gasoline high emitters to ambient PM concentrations. Vehicles will be recruited from the Kansas City Metropolitan Area (KCMA) (see Figure 1). **The sample size estimation was derived from data based on a previous study (CRC E-24) in which EPA estimated the initial sample size, estimated the effective sample size, and then allocated the effective sample among strata.(see Appendix B)** For the purposes of this task order the KCMA consists, at a minimum, of the counties of Wyandotte and Johnson in Kansas; and Jackson, Cass, Clay, and Platte in Missouri. In order to increase the likelihood of obtaining a representative sample population and a high participation rate, the contractor will obtain a cohort, (existing or newly developed), from which vehicles will be randomly recruited for emissions testing. The cohort shall include a socioeconomically diverse group of citizens that represent the demographics of the KCMA. Additionally, the contractor shall compare the characteristics of the vehicles owned by the cohort to those of the Kansas City and national fleets to assess the representativeness of the cohort population. The contractor shall include an assessment of the effect of non-respondents to the cohort development program. In addition, the contractor shall document and evaluate non-respondents to the emissions testing program to ensure non-biased sample collection. The following information will be required for this assessment:

- Geo-demographic data for the cohort including vehicle ownership, approximate residence location, and socioeconomic status.
- Vehicle characteristics for the cohort group including year, make, model, and mileage of all owned

vehicles.

- Comparisons of select volunteer vehicle's oxides of nitrogen (NO_x), carbon monoxide (CO), and hydrocarbon (HC) emissions to other vehicle emissions in the Kansas City fleet.
- Detailed on-road vehicle fleet characteristics for the KCMA.
- Vehicle registration database for the KCMA which includes both vehicle characteristics listed above and vehicle ownership (name and address).

Figure 1. Map of the Kansas City Metropolitan Area.



Vehicles will be recruited from the KCMA for two rounds of emissions testing: Round 1 during the summer, 2003 and Round 2 during the winter, 2003/2004. Two sources will be considered as sample frames for test vehicles.

Cohort Sample: The contractor shall draw a random sample of 400 vehicles from the socio-demographically representative cohort chosen by the contractor for the purpose of this project. The contractor shall also draw a random sample of 80 vehicles from non-respondents to the cohort (described in Section 3.1.3). The sample shall be stratified by vehicle age and class with target recruitment numbers as shown in Table 1. **EPA does not possess any cohort data for Kansas City or any other locality. However, EPA is aware of data being collected through a DOT Congestion, Mitigation Air Quality (CMAQ) grant administered through the Mid- America Regional Council (MARC) in Kansas City. The mention of this data does not constitute a recommendation to use this data set. In addition, there might be other sources of data available in the region. (Note: Specific guidelines have not been established on what constitutes a "diverse" population. In general, the contractor shall ensure that multiple ethnicities and socioeconomic classes are included in the project. The contractor shall also ensure the demographic data is obtained for all respondents.)**

Registration Sample: The Sponsors recognize that a demographically representative cohort group may not possess a sufficient mix of vehicles, or the vehicles may not be representative of the general fleet. The contractor shall provide the EPA representative with the vehicle registration database for the KCMA. The EPA representative shall randomly select 400 vehicles from this database **(vehicles from the cohort)** stratified by vehicle age and class with target recruitment numbers as shown in Table 1. The contractor shall also draw a random sample of 80 vehicles from non-respondents to the cohort (described in Section 3.1.3). The contractor shall obtain socio-demographic data on all vehicle owners chosen in this sample frame if this sample frame is used for recruitment. **(Note: EPA has not made prior arrangements with the States representing Kansas City for vehicle registration data. The contractor should contact MARC and the State's Department of Motor Vehicles to arrange for this data. EPA and Contractors shall consider all vehicle owner data acquired as confidential with proper safe guards to ensure its access is restricted. This personal data will be destroyed after the test program has ended).**

3.1.1 Sample Representativeness Assessment.

The contractor shall determine the representativeness of the cohort sample for use in vehicle recruitment. The contractor shall compare the characteristics of the cohort fleet, by make and model year, to the Kansas City area fleet and the national fleet. The contractor shall also compare vehicle exhaust emissions of NOx, HCs, and CO for select cohort vehicles and Kansas City fleet vehicles using new or previously collected remote sensing data **(RSD)**. **Existing RSD could be used for assessing sample representativeness if applicable. (Note: PM RSD measurements are not an acceptable method for comparing emissions from RSD response and non-response vehicles. RSD data for gaseous compounds does not always correlate well with PM emissions. In addition, PM RSD techniques are not well proven.)** Second-by-second chassis dynamometer emissions data from the Unified Cycle may be compared against remote sensing data collected from the Kansas City area fleet as one approach. Recommended standard remote sensing data collection protocols can be found at www.crcao.com (see E-23 Interim Report). The selected approach must be justified in detail to ensure representativeness of Kansas City area fleet remote sensing data to the general vehicle population and subsequent comparison of this data to the study test fleet including appropriate weighting of the data used in this assessment. The contractor shall also conduct a double blind comparison between the proposed sample obtained using the cohort sample frame and the proposed sample using the registration sample frame to ensure representativeness of the vehicles recruited for the program.

3.1.2 Vehicle Selection.

The contractor shall be responsible for documenting and contacting all owners of vehicles chosen for emissions testing. The contractor shall have the capability of multilingual recruitment (English and Spanish at a minimum) to ensure that a majority of the KCMA population can participate in the program.

If the cohort sample is deemed representative, this database will be used for vehicle recruitment. Otherwise, the registration sample will be used by the contractor for recruitment. All vehicles in the sample frame shall be binned into a sample stratum. Vehicles shall be randomly selected from each stratum, so that all vehicles in the stratum have an equal probability of selection. **(This means that all vehicles in the cohort sample will be assigned to a stratum based on year and type of vehicle and then vehicles within each stratum will be randomly selected.)** The total number of tests to be performed for the program is shown in Table 2.

Table 1. Estimated Sample Sizes by Stratum to Achieve Data Precision Goals (includes positive respondents and non-respondents).

Stratum (*h*)	Vehicle Class	Age Class	Sample size (n_h)[1]
1	Truck	Pre 1980	50
2	Truck	1980 – 1990	100
3	Truck	1991-1995	70

4	**Truck**	**1996 and newer**	**40**
5	**Car**	**Pre 1980**	**40**
6	**Car**	**1980 – 1990**	**50**
7	**Car**	**1991-1995**	**80**
8	**Car**	**1996 and newer**	**50**
Total			**480**

Table 2. Estimated Number of Vehicles Recruited and Test Performed

	Different Vehicles	Tests
Round 1		
Positive Respondents from Cohort	170	170
Replicate Vehicle Tests	0	15
Non-respondent from Cohort[a]	80	80
Weekly calibration vehicle test [b]	0	12
Total	**250**	**277**
Round 2		
Positive Respondents from Cohort	230	230
Non-respondent from Cohort[a]	0	0
Replicate Vehicle Tests	0	10
Repeat Vehicles from Round 1[b]	25	25
Weekly calibration vehicle test [b]	0	12
Total	**255**	**277**

[a] see Section 3.1.3 for description of this activity.
[b] see Section 3.2.3 for description of this activity.
Total vehicles includes non-response assessment.

3.1.3 Non-Response Assessment.

As part of the recruitment process, the contractor shall randomly select eighty (80) people who did not positively respond to the initial request to participate in the cohort. These owner's vehicles will be recruited to the program to assess any potential bias in results from the recruitment of volunteers to the study. A list of non-respondent criteria will be developed with approval from the EPA Project Officer after consulting with the Sponsors. As shown in Table 3, the number of vehicles to target in each stratum for the non-response analysis shall be proportional to the vehicles recruited for the total population. **The contractor shall propose criteria to determining methods that achieve a high participation rate for non-respondents which might include different incentive packages for different cohort stratum. The contractor can propose a different criteria for what constitutes a non-respondent but shall provide documentation supporting its approach.**

Table 3. Estimated Sample Sizes by Stratum for Non-Respondent Testing

Stratum (*h*)	Vehicle Class	Age Class	Sample size (n_h)[1]

1	Truck	Pre 1980	8
2	Truck	1980-1990	16
3	Truck	1991-1995	12
4	Truck	1996 and newer	7
5	Car	Pre 1980	7
6	Car	1980 – 1990	8
7	Car	1991-1995	14
8	Car	1996 and newer	8
Total			**80**

1 Number of randomly selected vehicles tested for the non-response assessment.

3.1.4 Participation Incentives

Incentives will be required for study participants. At a minimum, participants will require the use of a rental vehicle during testing of their vehicle. Other likely incentives include cash, free gasoline, free repairs, and free cleanup of participant vehicles. Since the vehicles will likely be randomly chosen from the cohort, incentive requirements may be less than for previous testing programs. However, incentives must be adequate to ensure the lowest possible rejection rate from study participants. **Incentive packages will be reviewed and refined in a pilot study program as described in section 3.1.5 in order to assure a high participation rate and reduce both contractor time and cost. If a vehicle is rejected for some reason when the vehicle is inspected (see section 3.2.1), the potential participant should be compensated for their time and trouble. The contractor shall propose a rejection participation package if this situation occurs.**

From previous studies, the Sponsors have developed an outline on the cost of incentives that might be used by the contractor to reduce rejection rates. The contractor can propose other incentives packages that they feel might improve the response rate for the program and/or reduce contractor's time in managing the incentives program.

A separate emission and activity program involving portable emission measurement system (PEMS) or portable activity measurement system (PAMS) will need additional incentives for selected participants whose vehicles would have this device. See Section 3.2.4 for details.

The contractor will propose a budget for achieving these goals outlined in this section. Monthly progress reports itemizing incentive expenditures and details on those expenditures shall be provided to the Contracting Officer and the Project Officer. The Contractor shall notify the Project Officer when 75% of the incentive funds have been expended.

Table 4. Incentives.

Type of Incentives	**Incentive Cost**
Cash	$200 (if using a rental vehicle) $275 (for not using a rental vehicle)
Full Tank of Gasoline	$25
Rental Vehicle	$75 (for up to three days)
Car Wash (possible)	$10
PEMS / PAMS Use	$50
Total	**$360**

3.1.5 Vehicle Recruitment Pilot Study

The contractor shall conduct a pilot study to evaluate recruitment methods and incentive packages to identify the adequacy of the proposed recruitment process in achieving a high response rate from vehicle owners (positive respondents and non-respondents) and to assure proper flow of vehicles for emission testing. **The contractor shall propose methods and evaluate methods from this pilot study. The contractor shall include in their proposal methods that will be used for contacting participants that include: mode of contact (phone calling, letter) , number and frequency of contacts, and incentives.** The pilot vehicle recruitment study should indicate cost savings in reduced contractor's time burden and savings for recruiting vehicles. **Vehicles do not have to be recruited during this pilot study but focus groups could be used as one way to evaluate recruitment methods and incentive packages for different geodemographic groups.**

3.1.6 Data Management.

The contractor shall maintain all data records, and make all databases used in the assessment accessible to the EPA Project Officer and to the Sponsors. The contractor shall document all statistical methods used in determining the representativeness of the vehicles chosen for the sample frame. The contractor shall also maintain a list of all vehicle owners contacted for recruitment to the study. The contractor shall list the person contacted, socio-demographic information associated with each person contacted, the response, and the incentives required, if the response is positive. To identify all people contacted for participation in the study, the contractor shall use a confidential, unique identification code to protect the privacy of all individuals.

3.2 Vehicle Testing

All vehicle testing will occur outdoors under ambient conditions. The contractor shall select a suitable location that provides security and accessibility for all project participants. The general testing site area needed to conduct **the** program is approximately 100 ft x 200 ft for equipment (transportable dynamometer and trailers) plus room for vehicles. The contractor shall provide cover to ensure that all equipment and vehicles are protected from the elements during participation in the study. The contractor shall be responsible for identifying and procuring a suitable location for conducting the emissions tests **and** covering the costs of shipping the portable dynamometer to **and from** the testing location in Kansas City **(dynamometer is located in Research Triangle Park Area, NC)**. The contractor shall be responsible for providing the following electrical power at the site needed to power the sampling equipment, and the dynamometer:

- 60 amp, 3 phase, 480 v.
- 200 amp., 1 phase, 240 v.

The contractor and subcontractor(s) are required to have insurance that covers vehicles procured from the public that might be damaged while in their possession. All vehicles whether they are insured or uninsured will be tested. (None, if any, uninsured vehicle should occur since State's require vehicle insurance.)

The contractor **may need to** provide vehicles for the duration of the study: a full-sized **vehicle** for moving heavy equipment and a **vehicle** for transporting people.

3.2.1 Vehicle Inspection, Maintenance, and Conditioning

All vehicles shall be inspected upon arrival to the testing facility. To lessen the chance of an owner complaining that the car was scratched or damaged, a video recording **is recommended**. The major components of the inspection are engine condition (engine noises, whether it "knocks" or other "noises"), tire condition, brake condition, and integrity of the exhaust system.

All appropriately equipped vehicles shall have their OBD system scanned. The scan results shall be reported along with the type of OBD systems found on the vehicle, such as OBDI or OBDII. Any defects or deficiencies in the vehicle condition that pose a danger **to testing personnel will be repaired by the contractor. Any defects or deficiencies in the vehicle condition that will not affect exhaust emissions**

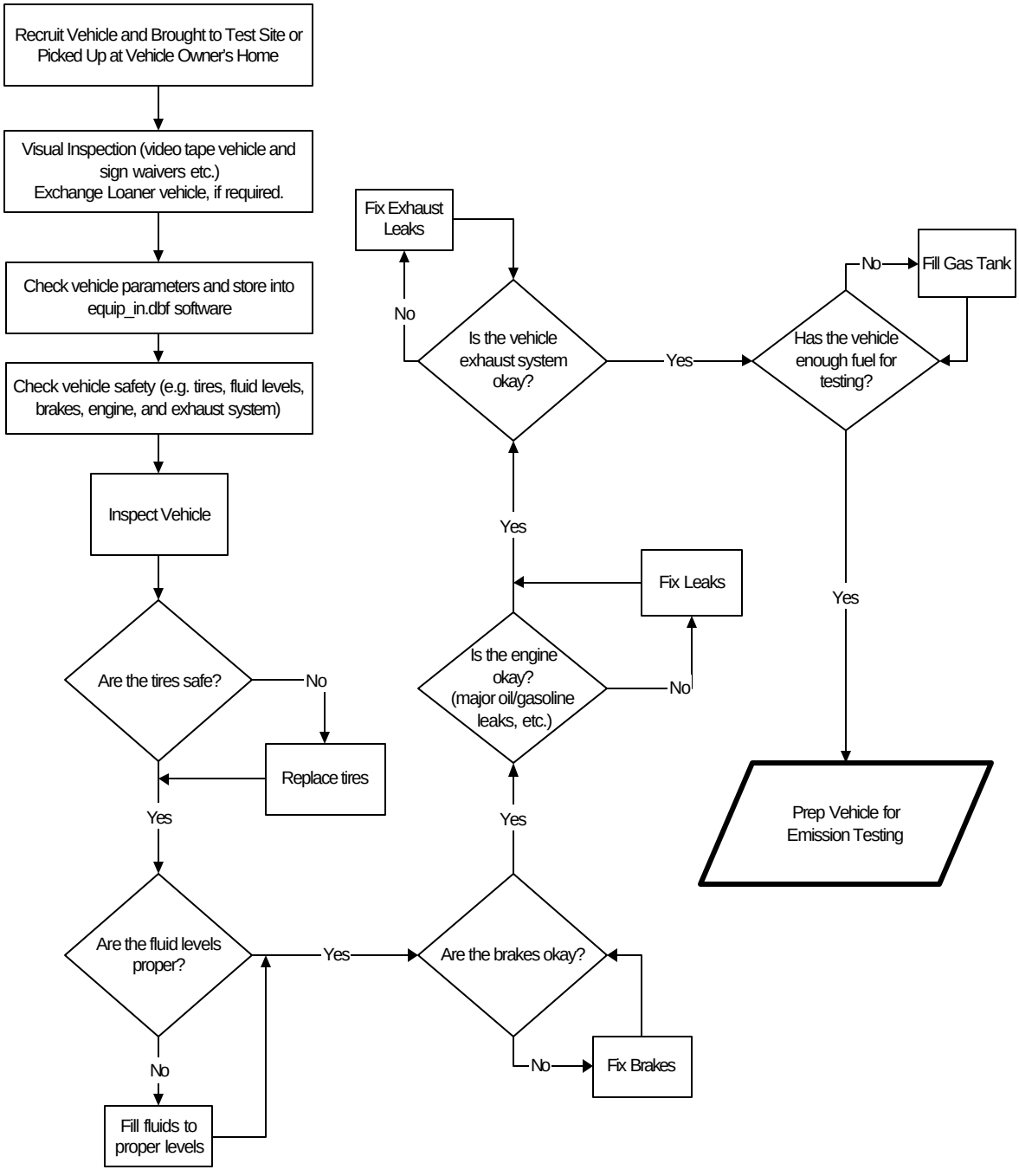
will not be repaired by the contractor since the goal of the project is not to reject any vehicle due to operating condition. All repairs shall be documented. If a vehicle cannot be repaired to a condition that does not pose a safety risk to project participants, the vehicle must be rejected. Detailed information on all vehicles must be obtained and recorded for the overall vehicle study **even if a vehicle is rejected**. **Portable Emission Measurement Systems (PEMS) or Portable Activity Measurement Systems (PAMS) devices might be used to further characterize these rejected vehicles.**

Initial vehicle data will be collected and recorded on a computerized vehicle information form. Recorded information is not limited to but will include date and time of vehicle procurement, date and time of vehicle testing, test number, vehicle license plate number, make, model, model year, odometer, engine family number, vehicle identification number (VIN), evaporative emission number, engine displacement, number of cylinders, emission controls, catalyst type, vehicle registration status, and fuel and oil information. Condition of the motor oil (e.g. clean or new vs. used/dirty) will be reported. A visual and odor inspection of the exhaust will also be noted to determine in advance whether or not a vehicle might be a low or high PM emitter **or smoker**. All information will be documented for each vehicle brought to the testing facility, regardless of whether the vehicle is tested.

After the vehicle has passed inspection, it shall be conditioned for testing. Conditioning will occur by driving the vehicle on a route pre-established by the contractor in the vicinity of the testing location. The conditioning route must contain multiple high speed accelerations, a minimum of ten minutes of continuous high speed operation, and low speed operation and idling just prior to the completion of the conditioning route. After conditioning, the vehicle shall soak overnight prior to emissions testing on the dynamometer. Portable activity measurement system (PAMS) might be used to compare conditioning differences between vehicles.

Vehicles will be observed for visible smoke during vehicle processing and after the initial dynamometer test. A test will be developed by the contractor for smoke observation as part of the vehicle conditioning process. Based on observations during this test, vehicles will be characterized in the smoker category **(measured by color)**, if appropriate.

Figure 1a - Vehicle Inspection Flow Diagram



3.2.2 Vehicle Testing Procedures and Equipment

Vehicles will be brought to the testing facility randomly for testing by the contractor. No predetermined order for testing should be incorporated. However, if the vehicle pre-inspection does indicate that a vehicle might be a high emitter (due to smoke, smell, etc.), that vehicle shall be tested last in the day. A calibration (or control) vehicle will be used weekly to test the dynamometer system. The contractor shall report the control vehicle weekly results before beginning the next week of vehicle tests. **As part of the Quality Assurance Project Plan (QAPP) and Quality Management Plan (QMP), the contractor shall develop guidelines or standards for vehicle inspections and testing of vehicles.**

3.2.2.1 Dynamometer Testing

Vehicle exhaust emissions testing will occur using the EPA Office of Research and Development (ORD) transportable chassis dynamometer (refer to Section 3.2).

The contractor shall provide a cost break down for both options listed below. EPA will decide during proposal review which option to select.

Scenario A - EPA's ORD provides the dynamometer testing equipment, the contractor operates and is responsible for all costs.

Scenario B - EPA's ORD provides the dynamometer testing equipment and the dynamometer's operation occurs under a separate contract and the contractor needs to coordinate with the contractor operating the dynamometer.

The information in this section is for the contractor's information only. However, the contractor awarded this task order must ensure that data collected **through either option** is integrated into the program.

The EPA dynamometer simulates driving on a Clayton Model CTE-50-0 chassis dynamometer. The dynamometer is capable of simulating a continuous spectrum of loads from three to 50 hp @ 50 mph and inertias from 1750 to 3000 pounds in 250-pound increments and 3000 to 5500 pounds in 500 pound increments. Cooling fluid for the dynamometer's water brake power absorption unit consists of a 50/50 mixture of water and glycol. The fluid is recirculated and cooled by a self-contained pumping and cooling system. Test inertia and hp settings for the dynamometer will be determined from computerized EPA I/M lookup tables and recorded on the vehicle test form.

Vehicles will be operated over the LA92 Unified Driving Cycle (shown in Figure 2). The LA92 cycle will consist of a cold start Phase 1 (first 310 seconds), a stabilized Phase 2 (311 – 1427 seconds), a 600-second engine off soak, and a warm start Phase 3 (repeat of Phase 1 of LA92), PM filter collection will occur separately for phase 1, phase 2, and phase 3.

A positive displacement pump-constant volume sampling (PDP-CVS) system will be used to quantitatively dilute exhaust gas from the vehicle operating on the dynamometer. The PDP-CVS system is constructed of an 8-inch diameter stainless steel dilution tunnel and a SutorBilt Model GAELAPA (6-LP) PDP operating at 500 CFM. Dilution air is treated with a charcoal bed (for HC stabilization) followed by a HEPA filter (99.97% DOP filter efficiency) to remove particles prior to mixing with vehicle exhaust.

During transient testing, the dilution tunnel temperature shall be kept constant at 47±5˚C to prevent loss of volatile PM components from high temperature portions of the driving test cycle and because of the dominance of volatile PM components from low temperature portions of the driving test cycle. Maintenance of a constant temperature will also enable PM instrument sample temperature controls to operate more effectively.

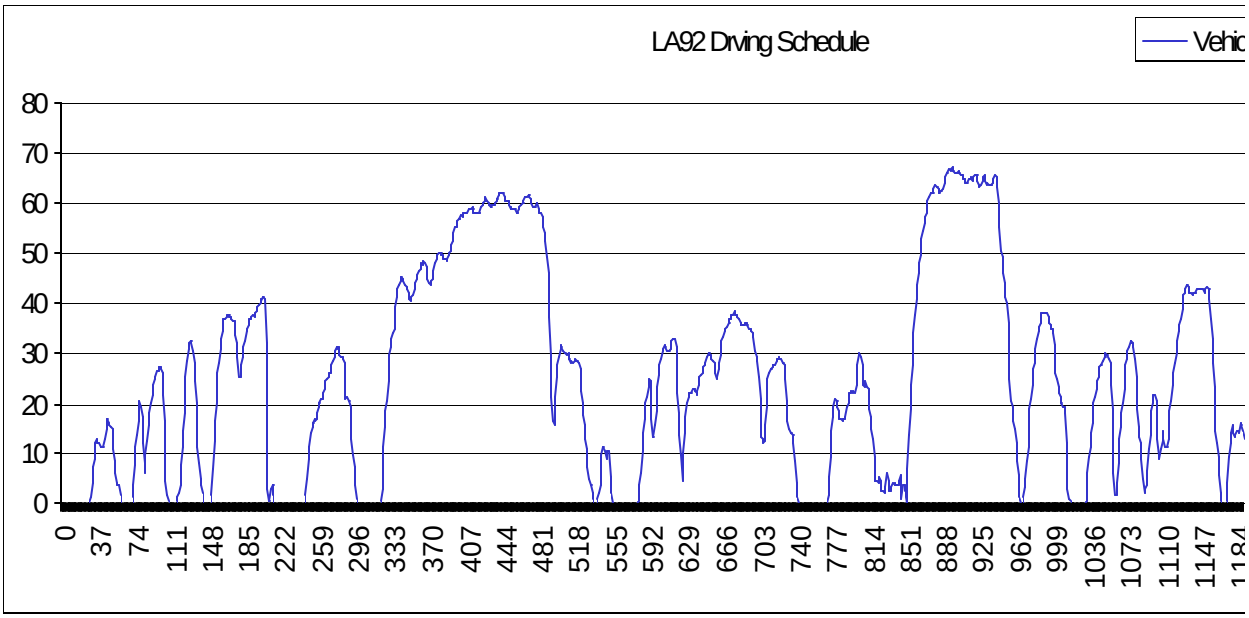


Figure 2. LA92 Driving Cycle.

As part of the tunnel conditioning process, the CVS and tunnel dilution air heater shall be turned on at least ten (10) hours prior to engine start and run to purge the exhaust transfer line and dilution tunnel. Pilot testing results may indicate that less than ten hours is sufficient. Pumps at the analytical bench shall be run at least one (1) hour prior to engine start to purge all sample lines. The CVS, tunnel heater and sample pumps shall be kept running throughout the day and will not be shut down until the conclusion of testing for that day. Testing shall not be started until the temperature in the dilution tunnel has reached a stable value (no increase in temperature over a 3 minute period).

Within two (2) minutes of the start of the initial test of the day, background THC, CO, NO_x, and CO_2 concentrations in the dilution tunnel shall be recorded by the regulated emissions bench operator. These levels shall serve as reference background levels for the tests that immediately follow that day. If prior to the start (within 2 minutes of start) of succeeding tests that day, the background levels measured for that test differ from the reference background by more than $\pm$15%, testing shall be delayed until corrective measures are taken. If the greater than $\pm$15% change in background is due to a change in the ambient background level (not influenced by station exhaust or spillage) and cannot be corrected, the testing may resume with a new set of reference background levels. However, after each test, the ambient background levels shall be monitored by the bench operator so that the reference background levels can be adjusted if ambient levels continue to change.

Background levels of THC from the tunnel filter shall also be monitored by the instrument bench operator for fifteen (15) minutes before the start of a test. If the background level of THC in the dilution tunnel differs by $\pm$15% of the background level of THC after the tunnel filter, the test shall be delayed until tunnel levels are adjusted accordingly.

PDP and ambient temperatures will be monitored with Type K thermocouples coupled to Omega readout meters. Relative humidity and atmospheric pressure are also measured electronically. Vehicle speed will be measured using a digital optical encoder as part of the driver's aid system. The emission measurement system has the capability to measure both continuous and bag emission measurement for the following pollutants (THC, Nox, CO and CO_2). Emission measurements gathered in bags and processed through a GC can be used as a QC procedure to compare to emissions being measured on a continuous basis.

A pentium class computer will be provided by EPA to be used to log real time output signals from the

regulated emissions instrumentation and meteorological and speed sensors. The computer is equipped with two A/D boards (Data Translation model numbers DT2801A and DT2821). Each A/D board will provide eight (8) differential analog input channels for recording data and sixteen (16) digital output channels for control of sampling solenoids. The real-time system is controlled by a commercial software package, Labtech Notebook. Labtech Notebook is a menu driven software package used to configure sampling rates, engineering conversion factors, data storage modes, etc., for each sampling and control channel.

3.2.2.2 Vehicle Fluid Sampling

Fuel and oil samples will be collected by the contractor from all feasible vehicles after completion of the dynamometer test(s). Fuel samples from different grades will also be collected from five local gasoline distributors to account for newer vehicles in which fuel samples cannot be collected. The fuel and oil samples will be analyzed for sulfur content, aromatic content, elements (see Section 3.3.2.7), and speciated HCs (see Section 3.3.2.5). Approximately 2-3 ounces of sample will be collected from each vehicle to allow excess sample to be retained by the contractor for a period of two (2) years after completion of the task order for potential future compositional analysis. If EPA requires any samples to be analyzed beyond what is specified in section 3.3.2.7, EPA will pay for shipping cost through a different contract mechanism. Two years after testing has been completed, ownership of samples revert to the contractor. Disposal of samples may be accomplished by taking them to the local recycling station.

3.2.3 Quality Assurance for Vehicle Testing

Dynamometer calibration checks will be performed on a daily basis through a combination of coast-downs and speed calibrations. PDP rpm will also be checked on a daily basis. The dynamometer's torque sensor is calibrated after field set up using dead weight techniques. PM mass and EC tunnel blanks will be collected to ensure no significant background problems for the measurement of regulated emissions.

Second by second data shall be aligned to vehicle tractive power and shall be done through the testing of a vehicle over the test cycle to be used in this test program, the LA92 (Unified Cycle). This process is only necessary during the configuration or reconfiguration of the sampling system. This configuration also includes variations in the sampling pipe from the vehicle to the dilution tunnel. Conceivably, different sampling pipes will require different alignment values. Using parameters for light duty vehicles on a flat (zero grade) roadway this equation can use the following form:

VSP (kW/metric Ton) = 1.04* v*a+ 0.132*v+00.00121*v^3;

where v is in units of m/s and a in m/s/s. This assumes a value for rolling resistance, **aerodynamic** drag, vehicle mass, engine efficiency (the 1.04 coefficient of the v*a term), etc., which will vary from vehicle to vehicle. However, this is sufficient because only timing is being considered.

The contractor shall correlate all the gases to VSP; this is done any time that there is a change in the plumbing or instrumentation. The best correlation between each gas and VSP shall be determined by shifting the emission results in relation to VSP. The time shift for individual analyses shall be the offset used between vehicle's speed and its corresponding emissions.

For the field testing, round-robin comparisons will be made between the transportable dynamometer in Kansas City (ORD's transportable dynamometer) and the EPA laboratory dynamometers in Ann Arbor, MI. Three vehicles will be tested at the Ann Arbor labs **(each vehicle tested in triplicate)** and shipped to Kansas City for testing on the transportable dynamometer. The types of vehicles might include a new, low mileage vehicle; an intermediate mileage vehicle (approximately 50,000 miles); and a high mileage, high emitting vehicle. The contractor shall be responsible for arranging for testing and conducting sample analyses in Kansas City and vehicle shipment to and from Ann Arbor, MI. The contractor will also be responsible for doing sample analyses for the Ann Arbor samples. **EPA will provide the vehicles for the contractor to use during this test program.**

As another possible QA procedure, all vehicles shall pass by a remote sensing device multiple times. The contractor can choose to conduct this testing during the preconditioning route or after emissions testing on

the dynamometer. The data will be used to compare with the other continuous emission monitoring devices (PEMS units and the dilution tunnel measurements). The data may also be used to determine the representativeness of the vehicle in relation to the Kansas City regional fleet for HC, CO, and NO_x emissions.

Twenty-five vehicles tested during Round 1 of the program will be re-tested during Round 2 to determine comparability between testing Rounds. These vehicles will be randomly selected from each stratum as shown in Table 5. This data may also provide information on the effect of ambient temperature on PM emissions.

Table 5. Estimated Sample Sizes by Stratum for Round 2 Re-Testing

Stratum (*h*)	Vehicle Class	Age Class	Sample size (n_h)[1]
1	Truck	Pre 1980	3
2	Truck	1980-1990	5
3	Truck	1991-1995	3
4	Truck	1996 and newer	2
5	Car	Pre 1980	2
6	Car	1980 – 1990	3
7	Car	1991-1995	4
8	Car	1996 and newer	3
Total			**25**

[1] Number of randomly selected vehicles tested during Round 1 re-tested during Round 2.

3.2.4 PEMS and PAMS Vehicle Testing.

To advance the Sponsors' understanding of "real world" vehicle operations and emissions and to create realistic airshed models of mobile sources, the contractors shall install PEMS and PAMS units on randomly selected vehicles. EPA will provide technical information on which vehicles will receive the PEMS and PAMS units **(see Appendix C as a reference users manual of a typical PEMS type unit)**. EPA will be looking for a mixture of vehicles as specified in Table 5 and will also target vehicles based on their emission rates and mileage. These devices can record measurements on a second-by-second basis in the following areas: environmental conditions (e.g., ambient temperature, humidity, barometric pressure, etc), vehicle parameters (engine rpm, vehicle speed, air conditioning on, OBD codes, etc), date/time stamp, and emissions (HC, NOx, CO and CO_2). **PEMS has the capability to operate from battery only for 8 hours or for 16 hours with two batteries. For multiple day data gathering would require the recharging of batteries which can occur two ways: recharging by electrical outlet overnight or from the vehicle's electrical system during vehicle normal operating. Fuel to operate the FID analyzer lasts for 8 hours of continuous operation**.

The PEMS and PAMS devices will be installed into the owner's vehicle trunk either at the testing facility or at the owner's home. Installation and removal requires about one hour which includes calibration, quality assuring and quality controlling (QA/QC) the equipment. All calibrations and QA/QC procedures shall be recorded and documented for each vehicle. EPA expects that 10 – 20% of the vehicle's might require an additional hour because of either installation or calibration issues. After installing the PEMS/PAMS device, the vehicle owner operates the vehicle in a normal fashion that would be typical for that day(s). The owner will be required to record in a log a date and time that certain events occurred such as changes in the vehicle's load (e.g., number of passengers in vehicle entered and left the vehicle or other items such as groceries or packages, etc). Installation and removal of the PEMS/PAMS equipment can occur at either the vehicle emission test site **or** at the vehicle owner's home. **The contractor shall provide a strategy for testing vehicles using PEMS/PAMS devices.**

Table 6. Use of PEMS and PAMS Devices.

Type of Device	Number of Days	Number of Vehicles	
		Round 1	**Round 2**
PEMS	**1- 3**	**20** per device (**16** vehicles per week)	**20** per device (**16** vehicles per week)

PAMS	1-7	10 – 12 per device (1 vehicle per week)	10-12 per device (1 vehicle per week)

EPA plans on using **up to** eight PEMS/PAMS devices (depending on which device types are available at the time of testing) on the recruited vehicles to gather either activity or both activity and emissions data during the timeframe specified above. EPA will provide the equipment and training in Kansas City at no cost to the contractor. PEMs devices will be on the vehicle for an average of **three days with some vehicles being repeated to look at the difference between weekday and weekend driving habits.** The maximum amount of data that would be gathered is between **6 - 20** hours with a typical data set consisting of about **2 - 6** hours. PEMS devices will only be used in vehicles that will be operated for at least an hour on that day. The contractor will be responsible for the installation, removal of instrumentation from the vehicle, equipment calibration and maintenance, data storage, maintaining Quality Assurance Project Plan (QAPP) and Quality Management Plan (QMP) procedures and data format conversion (if needed). The contractor will perform a PEMS evaluation comparing second-by-second data between the dynamometer and "real-world" for each vehicle. The contractor might need to provide additional incentives to owners who are selected to have one of these devices installed. PAMS devices will be used to gather "real world" activity of a vehicle so there will be no minimum amount of vehicle use required. **The contractor shall also price the cost of operating PEMS on a per vehicle basis.**

3.2.5 Data Management.

The contractor shall maintain and provide the EPA's Project Officer and all Sponsors with all records associated with vehicle inspection, maintenance, and testing. All vehicle identifiers shall coincide with the identifiers used for vehicle recruitment. Data must be collected for all vehicles recruited to the project, even if the vehicle is not tested.

Data shall be delivered in the input formats for EPA's relational database Mobile Source Observation Data Base (MSOD). The formats are described and defined in Attachment A.1. Delivered tables shall be accurate and complete before they are forwarded to the Sponsors. Any time a significant change or changes to the test program or its software are adopted, the contractor shall again perform a complete comparison of the data from the first affected test vehicle to the .dbf data tables generated for that vehicle (See section 4.2 for further data management issues).

3.3. Sample Analysis.

Chemical and physical analyses of the samples collected during vehicle testing will be required to support the study. Results from the chemical and physical characterization of the exhaust emissions will provide information for the SPECIATE emission factor database, profiles for source apportionment studies, and air toxics emission estimates for trends assessments. Table 7 lists the number of samples that need to be collected. The contractor shall assume that no compositing of samples will be required. However, results of the pilot study may indicate that sample compositing is required. The contractor shall develop as part of the QAPP, a methodology for regularly transferring and review of all data streams within this project. **Not all samples will be analyzed, so the contractor shall propose one or more statistical approaches to choose samples to be analyzed to meet budget limitations. Compound analyses shall be conducted in a timely manner to ensure the integrity of the sample collected. The contractor shall specify the time between sample collection and analysis and the anticipated recovery rate for volatile species. EPA recognizes that results of the project may be used to develop source apportionment profiles. Contractors may compare these profiles with previous studies.**

Table 7. The number of samples to be collected for each testing Round.

Type of Sample	# of vehicles	LA92 Cycles	# of samples per cycle	# of bkgnd per cycle	Total
Integrated Samples					
PM Mass Filters	277	1	3	1	1108
Elements Filters	265	1	0	0	0
EC/OC Filters	277	1	3(*)	1	1108
Ion Filters	265	1	1	0	265
SVOC PUF or denuder & filters	265	1	1	0	265
VOC summa canisters[a]	265	1	1	0	265
Aldehyde DNPH cartridges	265	1	1	0	265
Continuous Sample Periods					
QCM	277	1	1	1	554
TEOM (Continuous/Integrated)	277	1	2 (LA92 phase 1 & 3 only)	2	1108
EC	277	1	1	1	554
Nephelometer	277	1	1	1	554

[a] The contractor may use the PM mass filter for the elements analysis after weighing for mass.
* EC/OC testing requires two, back-to-back quartz filters for each sample. The backup filter is accounted for as a dynamic filter blank listed in Table 8.

Measurement methods to be used in this project include continuous air monitoring, integrated air sampling, and vehicle fluid grab sampling. Continuous methods for measurement of fine particle mass provide several useful data products as well as immediate feedback about the nature of the emissions from vehicles. These methods are ideally suited to identify the portions of a driving cycle where particulate emissions are greatest and least. Rapid time response is also useful for identifying potential high emitting vehicles and determining the conditioning status of the dilution tunnel. The integrated measurements allow for detailed analysis of chemical components present in the vehicle's exhaust for which no continuous methods exist. Grab samples will be used to identify the composition of the fuel and oil used in each vehicle during testing to assess potential mass balance relationships for specific compound emissions.

PM continuous and integrated air measurements will be extracted from the dilution tunnel through a low particulate loss 2.5 um cut point pre-classifier. The sample shall be isokinetically partitioned among the sample and direct measurement instruments using a sample distribution manifold. Throughout the sample extraction and partition process, the temperature of the sample air just before the PM filter shall be maintained at 47 ± 5˚C to ensure that PM sample loss due to thermophoresis is kept to a minimum.

Sample transport from the partitioning system to the individual instruments and sample collection fixtures shall be through straight, short transport lines. These lines shall be heated to maintain sample temperature. This will ensure that PM sample loss due to diffusion and thermophoresis is kept to a minimum. Sample transport lines shall also be of comparable length.

EPA will be providing equipment for some of the testing to be performed (see Appendix D). The contractor can also submit alternative equipment that they feel is as good or better than what is provided by EPA. The contractor shall justify the use, accuracy and cost of such equipment so that a proper evaluation can be conducted.

3.3.1 Continuous Measurements.

Continuous measurements will be collected for $PM_{2.5}$ (mass and elemental carbon (EC)) and gaseous compounds (NOx, THC, CO_2, and CO). Each method provides useful information on the amount and composition of PM and gaseous emissions from motor vehicles. The contractor will be required to diligently monitor this equipment. Operating methods must be approved by the EPA's Project Officer through the Quality Assurance Project Plan (QAPP) described in Task 1.

Each of the continuous measurement instruments has its own sample environment control. These include control of sample temperature and, in the case of the TEOM, compensation for changes in sample air pressure. In addition, to ensure that sample water gain during the gravimetric analysis is compensated for in the continuous, real-time measurements, sample dew point for the continuous instruments should be controlled to maintain equivalent partial pressures for water.

3.3.1.1 $PM_{2.5}$ Mass.

For continuous $PM_{2.5}$ mass measurements, three methods will be deployed: a quartz crystal microbalance (QCM), a tapered element oscillating microbalance (TEOM), and a nephelometer. The QCM and TEOM records and reports total collected mass (μg) and average concentration ($\mu g/m^3$) measured during the specified collection period. The nephelometer reports a derived mass concentration ($\mu g/m^3$). Training for operating the QCM will be available to the contractor at no cost with the exception of travel. The training will occur in Kansas City, depending on the contractor's preference.

3.3.1.2 "Elemental" Carbon (EC).

EC concentrations ($\mu gC/m^3$) will be continuously measured using an Aethalometer™, the Desert Research Institute (DRI) Photoacoustic Sampler, or an equivalent method. The instrument chosen should have a minimum resolution of 1 second or less; although the contractor may suggest a higher setting to increase the sensitivity of the measurement. **The contractor can submit alternative equipment to be used to measure particulates, however, the equipment needs to have the ability to perform high time resolution measurements so that we can understand the relationship between activity and emission characteristics.**

3.3.1.3 Continuous Gaseous Compound Measurements (see section 3.2.2.1 scenarios)

The measurements listed in this section will be provided under separate contract **if Scenario B is chosen**. The contractor for this RFP must ensure that the data described in this section are integrated into this program.

In addition to PM collection, the EPA transportable dynamometer has a bench capability to measure total hydrocarbons, oxides of nitrogen and carbon monoxide. Total hydrocarbons (THC) will be analyzed with a Horiba model 236-Heated Flame Ionization Detector (HFID). Background THC will be monitored with a second HFID, a Horiba model FIA 34A. Oxides of nitrogen (NOx) will be analyzed with a Horiba Model CLA-220 Chemiluminescent instrument. Carbon monoxide and carbon dioxide will be analyzed with Horiba Model AIA-210/220 infrared (IR) instruments. A third IR instrument, a Horiba model AIA23-AS, will be used for analysis of low (< 1000 ppm) carbon monoxide concentrations. All six instruments are rack mounted and plumbed for introduction of zero, span, and sample gases through the use of solenoid valves and pushbutton controls.

3.3.2 Integrated PM and Gaseous Compound Analyses.

Integrated PM and gas samples will be collected to allow for detailed chemical characterization of exhaust components. Integrated samples for $PM_{2.5}$ mass, elements, EC/OC, ions, SVOCs, and gaseous air toxics will be collected. All analysis extraction and measurement methods must be approved by the EPA's Project Officer through the QAPP.

Filters will require treatment and representative chemical analyses before being used in the study. A minimum of two filters from each lot received from the manufacturers will be analyzed for species to verify that specifications established in the QAPP have been met. Lots will be rejected if they do not pass this acceptance test.

All filters will be individually examined over a light table prior to use for discoloration, pinholes, creases, or other defects. In addition to laboratory blanks, 10% of all samples will be designated as field blanks that follow all handling procedures, but do not undergo actual sampling. Duplicate laboratory analysis will be conducted for every 10 samples. Study protocols call for 10% replicate analyses. These are an important part of the QA/QC program since these are applied to determine replicate precision that allow for calculation of sample uncertainty.

Table 8 lists the anticipated number of blanks to be evaluated for the project. The numbers in Table 8 assume that tunnel blanks are collected at the end of the test day, before the start of the test day, and between each test for PM mass and EC. Ten percent of all samples will have associated field and analytical blanks, while three transportation blanks are evaluated for each shipment (numbers assume one shipment of samples occurs each week). **Not all samples will be analyzed, so the contractor shall propose one or more statistical approaches to choose samples to be analyzed to improve cost effectiveness. Compound analyses shall be conducted in a timely manner to insure the integrity of the sample collected. The contractor shall specify the time between sample collection and analysis and the anticipated recovery rate for volatile species.**

Table 8. Estimated number of blanks to be analyzed during each testing Round.

Type of Sample	Tunnel Blanks	Sample/ Field Blanks	Analytical Blanks	Transport Blanks	Total
Integrated Sample					
PM Mass Filters	332	144	144	36	656
Elements Filters *	0	27	27	36	90
EC/OC Filters †	332	1440	144	36	1952
Ion Filters	0	27	27	36	90
SVOC PUF or denuder & filters	0	27	27	36	90
VOC summa canisters	0	27	27	0	90
Aldehyde DNPH cartridges	0	27	27	36	90
Continuous Sample Periods					
QCM	332	332**	†	n/a	664
TEOM (Continuous/Integrated)	332	332**	†	n/a	664
EC	332	332**	†	n/a	664
Nephelometer	332	332**	†	n/a	664
THC	332	332**	†	n/a	664

* The contractor may use the PM mass filter for the elements analysis after weighing for Mass.
** Using humidified Zero Air.
† Field and analytical blanks are the same.

In addition to acceptance testing, some filters will require pre-treatment before sampling. Quartz-fiber filters may absorb organic vapors with time. Blank quartz-fiber filters used for the assessment of EC/OC will be heated in air for at least three hours at ~900˚C prior to acceptance testing analysis. Sets of filters with levels exceeding 1.5 ug/cm^2 for organic carbon and 0.5 ug/cm^2 for elemental carbon will be re-fired or rejected. Pre-fired filters will be sealed and stored in a freezer at -20˚C prior to preparation for field sampling.

The results of the laboratory filter treatments, chemical analyses, and visual inspections will be recorded in a database with the lot numbers as described in the data management section. A set of filter IDs will be assigned to each lot so that a record of acceptance testing can be associated with each sample.

3.3.2.1 $PM_{2.5}$ Mass.

$PM_{2.5}$ mass measurements will be determined gravimetrically by the collection of particulates on Teflon membrane filters. One filter will be used to collect LA92 Phase 1, cold start emissions, a second filter collecting emissions from LA92 Phase 2, and a third filter for Phase 3 for every vehicle tested. Phase 4 of the LA92 will not be run for this program. Unexposed and exposed Teflon-membrane filters will be used for gravimetric analysis. The filters will be equilibrated at a temperature of 20 ±5 ˚C and a relative humidity of 30±5% for a minimum of 24 hours prior to weighing. Weighing shall be performed on a microbalance with ±0.0001 mg sensitivity. The charge on each filter shall be neutralized by exposure to a polonium source for 30 seconds prior to the filter being placed on the balance pan. The balance operator shall also be grounded during filter measurement. Pre- and post-weights, check weights, and re-weights (if required) will be recorded as described in the data management section. All Teflon filters will be analyzed for mass. If practical, PM mass measurements should be conducted on-site. If on-site measurements are not feasible, shipping and handling of the filters should be minimized to the extent possible. All filters should only be handled in a clean room environment. The contractor shall minimize the amount of handling PM filters (one method for minimizing the handling by the use of cassettes). The contractor might need to use TX40 filters for some high PM emitting vehicles in order to capture these emissions. **A preferred standard for a clean room to measure PM filters is "Class 1000" standard and a balance that can record to a 0.1 microgram. The contractor can propose another system or equipment but will need to show justification for its use.**

3.3.2.2 Elements Analysis.

Chemical analyses will be performed on select Teflon-membrane filter samples that were collected for the $PM_{2.5}$ mass measurements. The contractor may also suggest collecting elements samples on separate filters. At a minimum, the following elements will be measured for these samples: S, Cl, Cr, Calcium, Silicon, Phosphorous, Boron, Na, Al, Copper, Iron, Mn, Ni, Zn, As, Hg and Pb. The contractor must demonstrate minimum detection limits using proposed analytical methods. The contractor may also recommend additional elements to be measured based on the objectives of the program and the measurement methods proposed. The additional elements listed above were important ones that came from the lube oil Comparative Toxicity Study. **Not all samples will be analyzed, so the contractor shall propose one or more statistical approaches for choosing samples to be analyzed to improve cost effectiveness.**

3.3.2.3 Elemental/Organic Carbon Analysis.

The thermal/optical reflectance (TOR) or thermal/optical transmittance (TOT) methods may be used to measure organic (OC) and elemental (EC) carbon. EC and OC will be measured using the pre-fired quartz fiber filters. The contractor shall conduct the EC/OC measurements using one of the two temperature protocols: 1) the IMPROVE temperature/oxygen cycle, or 2) the NIOSH 5040 temperature/oxygen cycle. The contractor shall also provide a cost estimate of running both temperature protocols on a single instrument. **Not all samples will be analyzed, so the contractor shall propose one or more statistical approaches for choosing samples to be analyzed to improve cost effectiveness.**

3.3.2.4 Ion Analysis.

Ion chromatography (IC) or an equivalent method will be used to measure water-soluble chloride (Cl^-), nitrate (NO_3^-), and sulfate ($SO_4^=$).

3.3.2.5 Fine Particles/Semi-Volatile Organic Compounds.

Organic compound samples will be analyzed by gas chromatography/mass spectrometry (GC/MS). XAD coated teflon-impregnated glass fiber filters and glass honeycomb denuders or polyurethane foam (PUF) cartridges are recommended to collect samples for speciated SVOC measurements. The number of filters and denuders required to prevent sample loss will be determined by the contractor, and validated during the pilot

study. At a minimum, the contractor shall measure the SVOC compounds listed in Table 12. The contractor should also recommend additional compounds, including methyl- and nitro-substituted PAHs, to be measured based on the objectives of the program and the measurement methods proposed. **Compound analyses shall be conducted in a timely manner to ensure the integrity of the sample collected. The contractor shall specify the time between sample collection and analysis and the anticipated recovery rate for volatile species.**

3.3.2.6 Gaseous Air Toxics.

Gaseous air toxic compounds will be collected by Summa canisters (for VOCs) or DNPH cartridges (for aldehydes and ketones). At a minimum, the contractor shall measure benzene, formaldehyde, acetaldehyde, 1,3-butadiene, acrolein, toluene, ethylbenzene, xylenes (p-,o-,and m-), styrene, n-hexane, napthalene, and MTBE. **Compound analyses shall be conducted in a timely manner to ensure the integrity of the sample collected. The contractor shall specify the time between sample collection and analysis and the anticipated recovery rate for volatile species.**

3.3.2.7 Fuel and Oil Analysis.

Fuel and oil samples will be collected from each vehicle and will be retained by the contractor for a period of two (2) year after completion of the task order for potential future compositional analysis. If EPA requires any samples to be analyzed **beyond what is specified here**, EPA will pay for shipping cost through a different contract mechanism. Two years after testing has been completed, ownership of samples revert to the contractor. At a minimum, the following elements will be measured for these samples: S, Cl, Cr, **Ca, Si, K, B, Na, Al, Cu**, Fe, Mn, Ni, Zn, As, Hg and Pb. The contractor must demonstrate minimum detection limits using proposed analytical methods. The contractor may also recommend additional elements to be measured based on the objectives of the program and the measurement methods proposed. The additional elements listed above were important ones that came from our Comparative Toxicity Study in lube oil. One hundred (100) fuel and oil samples will be selected by the Project Officer to be analyzed. Tables 9 and 10 show analyses to be performed for fuel and oil samples, respectively. **Disposal of samples may be accomplished by taking them to the local recycling station.**

Table 9. Fuel Sample Analyses.

Test	Method
Gravity, API	ASTM D4052
Density, kg/l	ASTM D4052
Reid Vapor Pressure, psi	ASTM D323
Sulfur, Wt %	ASTM D4294
Recovery, vol %	
Benzene, vol %	
Oxygenate, vol % (identify compound(s))	
T50	
T90	
Residue, vol %	
Loss, vol %	
Oxygen, wt %	ASTM D4615
Composition, Aromatics, vol %	ASTM D1319
Composition, Oelfins, vol %	ASTM D1319
Composition, Saturates, vol %	ASTM D1319
Carbon, wt fraction	ASTM E191
Hydrogen, wt fraction	ASTM E191
Hydrogen/Carbon ratio	ASTM E191
Research Octane Number	ASTM D2699
Iron, ppm	Elemental Analysis
Copper, ppm	Elemental Analysis
Tin, ppm	Elemental Analysis
Aluminum, ppm	Elemental Analysis
Boron, ppm	Elemental Analysis
Calcium, ppm	Elemental Analysis
Chloride, ppm	Elemental Analysis
Sulfur, ppm	Elemental Analysis
As, ppm	Elemental Analysis
Cr, ppm	Elemental Analysis
Phosphorous, ppm	Elemental Analysis
Silicon, ppm	Elemental Analysis
Nickel, ppm	Elemental Analysis
Lead, ppm	Elemental Analysis
Magnesium, ppm	Elemental Analysis
Sodium, ppm	Elemental Analysis
Zinc, ppm	Elemental Analysis

Water, % (Karl Fisher)	ASTM D4926
Motor Octane Number	ASTM D2700
Fuel Economy Number/C Density	ASTM E191
C Factor	ASTM E191
Net heating Value, btu/lb	ASTM D3338 or D240

Table 10. Oil Sample Analyses

Test	**Method**
Sulfur Content	ASTM D4294-90
Viscosity, cST 40˚C, kinematic	ASTM D445
Wear Particles, Total Ferrous Particles	ISO 4405
Iron, ppm	Elemental Analysis
Copper, ppm	Elemental Analysis
Tin, ppm	Elemental Analysis
Aluminum, ppm	Elemental Analysis
Boron, ppm	Elemental Analysis
Calcium, ppm	Elemental Analysis
Chloride, ppm	Elemental Analysis
Sulfur, ppm	Elemental Analysis
As, ppm	Elemental Analysis
Cr, ppm	Elemental Analysis
Phosphorous, ppm	Elemental Analysis
Silicon, ppm	Elemental Analysis
Nickel, ppm	Elemental Analysis
Lead, ppm	Elemental Analysis
Magnesium, ppm	Elemental Analysis
Sodium, ppm	Elemental Analysis
Zinc, ppm	Elemental Analysis
Water, % (Karl Fisher)	ASTM D4926
Glycol	**Infrared Analysis FT-IR**
Total Acid Number, mg KOH/g	ASTM D664
Chromium, ppm	Elemental Analysis

3.3.3 Quality Assurance and Quality Control Procedures for Equipment.

The contractor will follow and ensure quality assurance and quality control procedures described below

and throughout this statement of work are performed.

- Daily instrument blank. An appropriate blank will be run daily for each instrument. Generally this is run after the calibration check and before any samples are analyzed. This confirms that there is no carryover from the calibration check as well as confirming the blank or zero level of the instrument.
- Daily calibration. All instruments to be used in this study will have calibration checks run a minimum of once each day. These checks will confirm both response factors and retention times for both GC/MS analyses.
- Duplicate laboratory analysis for every 10 samples. Study protocols call for 10% replicate analyses. These are an important part of the QA/QC program since these are applied to determine replicate precision that allow for calculation of sample uncertainty.
- Control samples. The contractor shall analyze a variety of control samples for QA/QC purposes. These include calibration, replicate, collocated and blind QA samples.
- Recovery tests for selected analytes. Recoveries are determined within each sample by the addition of deuterated internal standards prior to extraction. For DNPH analyses internal standards will also be added.
- Determine and report minimum trapping efficiency. True measures of trapping efficiency are nearly impossible to determine due to the challenge of generating an appropriate standard stream of the analyte of interest. A more appropriate method is the use of backup traps to confirm that no quantifiable levels of compounds are getting through the first trap.
- Determine THC, CO, CO_2, NOx and PM from the control vehicle every week. This is done to determine if there is no drift in the dynamometer.

As stated, a number of filter blanks will be evaluated to ensure quality control. Three laboratory control blanks will be evaluated for each filter lot group to ensure accuracy of the laboratory measurement technique. In addition, a minimum of one transport and one field blank will be included with each shipment of filters for analysis. The transport blank will be shipped with each filter group, but not be removed from the shipping containers. The field blank will be removed from the shipping container, and loaded into filter packs, but not be subject to sampling. In addition, daily, dynamic tunnel blanks for PM mass and EC will be collected as described in the Vehicle Testing section.

(The following paragraph is required for both scenarios as specified in section 3.2.2.1) Under separate task order, regulated emission analysis instrumentation will be zeroed and spanned before each test. Calibration gases consisting of a NO in Nitrogen mixture (90.2 PPM NO) and a CO, CO_2, and Propane in air mixture (900 PPM CO, 300 PPM Propane, and 2.54 % CO_2) were obtained from National Welders. Cylinder concentrations will be verified through comparison to NIST standards. Zero air and the FID fuel (60% H2/40% He) will be obtained. CEM zero air is used with a certification of < 0.5 PPM CO, < 1 PPM CO_2, and < 0.1 PPM HC. Multipoint calibrations are performed on all of the regulated emissions analyzers after arrival in the field to confirm their linearity.

A quality control standard and a replicate from a previous batch will be analyzed by the contractor with each set of 10 samples. When a quality control value differs from specifications by more than ± 5% or when a replicate concentration differs from the original value (when values exceed 10 times the detection limits) by more than ± 10%, the samples will be re-analyzed. If further tests of standards show that the system calibration has changed by more than ± 2%, the instrument will be re-calibrated. All results will be recorded as described in the data management section.

3.3.4 Data Management.

All sample analysis data shall be provided to the EPA's Project Officer. Continuous measurements will have time stamps to determine the events occurring during sampling. The contractor shall provide documentation to associate continuous measurements with specific vehicle testing times and conditions. The contractor shall also provide filter identification codes to track and catalog all filter samples collected during the study. The filter identification codes shall allow for the identification of the vehicle(s) tested to obtain the sample. The contractor shall also prepare proper sample handling and tracking procedures (chain of custody) as required by the QAPP.

Data shall be delivered in the input formats for EPA's relational database Mobile Source Observation Data Base (MSOD). The formats are described and defined in Attachment A.1. Delivered tables shall be accurate and complete before they are forwarded to the Sponsors. Any time a significant change or changes to the test program or its software are adopted, the contractor shall again perform a complete comparison of the data from the first affected test vehicle to the .dbf data tables generated for that vehicle (See section 4.0 for further data management issues.) ID Codes shall be established for all samples (not just filters).

Table 11a. Potential instrument configuration for continuous and quasi-continuous measurement of PM.[a]

Instrument Manufacturer	Instrument Type (Measurement)	Sensor Technology	Time Resolution (sec.)	Sensor Operating Environment: Temperature Range (˚C)	Sample Flow Rate (Lpm)
QCM, RPM – 101 Booker Systems, UK	Inertial Micro-Balance (PM Mass)	Quartz Crystal/ Frequency Deficit	1	35 to 50	1 to 5
DPM Monitor, 1105a R & P, Albany, NY	Inertial Micro-Balance (PM Mass)	Tapered Element/Filter Frequency Deficit	15	35 to 50	1 to 3.5
Dataram – 4 Thermo MIE, Bedford MA	Nephelometer (PM light Scattering)	Photo Diode/Two Wavelength	1	35 to 50	1 to 2
Aethalometer, AE2 McGee Scientific, Berkeley, CA	Light Absorption (Black Carbon and PAH)	Photo Diode/Light Absorption at 800nm and 370nm	300	20 to 40	5

[a] The instruments listed are an example only, based on the descriptions in Section 3.3. The contractor may propose alternative instruments.

Table 11b. Potential instruments for integral measurement of PM.

Instrument Manufacturer	Instrument Type (Measurement)	Sensor Technology	Suggested Sample Media	Sample Operating Environment: Temperature Range (˚C)	Sample Operating Environment: Sample Flow Rate (Lpm)
Filter Holder 6186 R & P, Albany, NY	Gravimetric Micro-Balance (separate filters for LA92 Phase 1 and LA92 Phases 2-4.(PM Mass)	Gravimetric Micro-Balance	Teflo Filter	35 to 50	50 to 70
Thermo-Optical Carbon Aerosol Lab Analyzer Sunset Laboratory, Forest Grove, OR	Carbon Aerosol Analysis (PM Elemental and Organic Carbon Mass)	FID Detection of Thermaly Liberated CO_2	Pre-Fired Quartz Filter	35 to 50	2 to15
Filter Holder 6186 R & P, Albany, NY	ICP-MS and/or XRF (PM Element Mass)[b]	Analysis Dependent	Teflo Filter	35 to 50	50 to 70
Filter Holder 6186 R & P, Albany, NY	IC and AC (PM Water Soluble Ions)	Analysis Dependent	Quartz Filter	35 to 50	50 to 70
Filter Holder 6186 R & P, Albany, NY	GC/MS (PM SVOC)	Analysis Dependent	XAD-4 Coated Filter	35 to 50	50 to 70
Summa Cannister Anderson Instruments, Atlanta, GA	GC/MS (VOCs)	Analysis Dependent	Summa Cannister	35 to 50	Sample Dependent
DNPH Cartridge Anderson Instruments, Atlanta, GA	GC/MS (Aldehydes and Ketones)	Analysis Dependent	DNPH Cartridges	35 to 50	Sample Dependent

1 See Statement of Work

[a] The instruments listed are an example only, based on the descriptions in Section 3.3. The contractor may propose alternative instruments.

[b] The contractor may use the PM mass filter for the elements analysis.

Table 12. SVOCs Recommended for Analysis[a]

Compound	Compound
PAHs	**Steranes**
Naphthalene	20R,5a(H),14b(H),17b(H)-Cholestane
Acenaphthylene	20S,5a(H),14b(H),17b(H)-Cholestane
Acenaphthene	20R,5a(H),14a(H),17a(H)-Cholestane
Fluroene	20R,5a(H),14b(H),17b(H)-Ergostane
Phenanthrene	20S,5a(H),14b(H),17b(H)-Ergostane
Anthracene	22R,5a(H),14b(H),17b(H)-Sitostane
Fluoranthene	22S,5a(H),14b(H),17b(H)-Sitostane
Acephenathrylene	**Hopanes**
Pyrene	22,29,30-Trisnorhopane
Benzo[ghi]fluoranthene	17a(H)-21b(H)-29-Norhopane
Cyclopenta[cd]pyrene	18a(H)-29-Norneohopane
Benzo[a]anthracene	17a(H)-21b(H)-Hopane
Chrysene/Triphenylene	22R&S,17a(H),21b(H)-30-Homohopane
Benzo[k]fluoranthene	22R&S,17a(H)21b(H)-30-Bishomohopane
Benzo[b]fluoranthene	**Resin Acids**
Benzo[j]fluoranthene	Pimaric Acid
Benzo[e]pyrene	Isopimaric acid
Benzo[a]pyrene	Sandaracopimaric acid
Perylene	
Indeno[cd]fluoranthene	8,15-Pimaredienoic acid
Indeno[cd]pyrene	Dehydroabietic acid
Dibenzo[ah]anthracene	7-Oxodehydroabietic acid
Benzo[ghi]perylene	Abieta-6,8,11,13,15-pentae-18-oic acid
Coronene	Abieta-8,11,13,15-tetraen-18-oic acid
Retene	Abietic acid
Saturated Cycloalkanes	**Branched Alkanes**
Dodecylcyclohexane	Norpristane
Tridecylcyclohexane	Pristane
Tetradecylcyclohexane	Phytane
Pentadecylcyclohexane	iso-Nonacosane
Hexadecylcyclohexane	anteiso-Triacontane
Heptadecylcyclohexane	iso-Hentriacontane
Octadecylcyclohexane	anteiso-Dotriacontane

Nonadecylcyclohexane iso-Hentriacontane

[a] At a minimum, the compounds listed in this Table should be analyzed. The contractor should recommend additional compounds that they believe are important for the program related to emission inventory and source apportionment profile development including, but not limited to, methyl- and nitro-substituted PAHs.

4.0 Quality Assurance Project Plan

4.1 Preparation of Quality Assurance Project Plan and Quality Management Plan

The contractor will submit a draft Quality Assurance Project Plan (QAPP) **and Quality Management Plan (QMP)** to the EPA's Project Officer and to Sponsors for approval within thirty (30) days of task order execution. The plan will detail sample collection and analysis tasks and procedures for the proposed study and be implemented in the pilot study. A final QAPP will be submitted within thirty (30) days after completing the pilot study. Information on completing a QAPP can be found at http://www.epa.gov/quality/qsdocs/r5final.pdf. As part of the QAPP, we are proposing that ten samples collected during each vehicle round (1 & 2) will be analyzed by the contractor and an independent laboratory chosen by the EPA's Project Officer in a round-robin test. Two sample sets will be analyzed for each of the major analyses identified in this statement of work: gravimetric, elements, EC/OC, ions, SVOCs, and gaseous air toxics.

All analysis needs to be completed and reported before Project Officer can approve the start of Vehicle Testing Round 2. The contractor shall address how this will be accomplished in a timely manner to allow for quick data review and program review that includes technical direction by the Project Officer and Sponsors for vehicle testing in Round 2.

The project implementation plan will specify the details required to collect and analyze the source samples in a manner consistent with the objectives of the study. The plan will be developed in consultation with the EPA's Project Officer and Sponsors. The QAPP must be approved by the EPA's Project Officer before the contractor may proceed with sample analysis. The contractor may submit separate QAPPs to obtain approvals for specific tasks to expedite sample analysis for the project. The final QAPP will cover all aspects of this test program as outlined in this document including the following areas:

- provide contractual support in maintaining, calibrating, and operating mobile source emissions measurement equipment used in the field. The equipment may be, but is not limited to, the NERL transportable dynamometer, roadway integrated sampling systems, and remote sensing of vehicle emissions measuring systems (RSDs). The necessary support such as analyzing the collected samples, data processing, and report writing are included.
- pilot programs (including a report on all sample data analyzed)
- vehicle recruitment
- vehicle testing
- speciation
- quality assurance/quality control
- data management and integration
- data analysis
- oral and written reports
- a methodology for regularly transferring and review of all data streams within this project

4.2 Data Management

Data shall be delivered in the input formats for EPA's relational database Mobile Source Observation Data Base (MSOD) and Excel format

The formats are described and defined in Attachment A.1. Delivered tables shall be accurate and complete before they are forwarded to the Sponsors. Any time a significant change or changes to the test program or its software are adopted, the contractor shall again perform a complete comparison of the data from the first affected test vehicle to the .dbf data tables generated for that vehicle.

The level of precision for reporting the data is defined in the table specifications. However, it may be necessary to alter that specification at some time during the test program. Therefore all raw data files shall be preserved and delivered to the Sponsors in the instances that reprocessing becomes necessary.

The contractor shall inform the Project Officer when they believe the specified precision is inadequate or inappropriate. The EPA's Project Officer and the contractor shall then determine what changes in the format are necessary to accurately store the test data for future use in MSOD.

The test program may propagate new data types and coordination between the testing contractor and the EPA's Project Officer will need to occur to accommodate that data. The probable input tables for this statement of work are:

activity_in.dbf
equip_in.dbf
dynob_in.dbf
bag_in.dbf
tmeas_in.dbf
bmeas_in.dbf
time_in.dbf
ttime_in.dbf
trip_in.dbf
rmeas_in.dbf
scan1_in.dbf
scan2_in.dbf
ffbat_in.dbf
tpobd_in.dbf
repar_in.dbf
tmeas_in.dbf
obd_in.dbf

Vehicle information is reported in the table equip_in.dbf. Test level is reported in the tables dynob_in.dbf and tmeas_in.dbf. Phase (bag) level information is reported in the tables bag_in.dbf and bmeas_in.dbf. Second by second data is reported in the tables time_in.prg and rmeas_in.prg.
Any repairs to a vehicle are reported in the table repar_in.dbf.

Before delivery of any test data to the EPA's Project Officer, the Contractor shall process the completed data tables through their quality assurance program. If the contractor chooses to use EPA formats, the EPA's Project Officer shall provide quality control programs to check the data against, EPAVALDATA and SBSCHK.prg. These programs shall check the data table for inconsistencies and errors that would interfere with their loading into EPA OMS/ASD's EF database (MSOD).

If the contractor enters the data by hand into tables, the contractor shall take extra precautions to assure typographical and transcription errors have not occurred.

The testing contractor must identify all tests with a unique test identifier (ctr_tst_id) that shall be no greater than 12 characters in length and a sequential bag number; 1, 2, 3, or 4 for each test phase. All subcontractors shall identify their test results for the appropriate sample using these same identifiers. The subcontractors shall follow the same specifications for data reporting and perform all the quality control steps outlined in this statement of work.

The program EPAVALDATA shall be used to determine the suitability of field level data within the individual tables in the EPA format with some cross level checking of test and vehicle weights. Some examples of fixes to the data tables that are normally found from data submitted to the EPA's Project Officer are: 1) WA_ID names misspelled or not in CAPITAL letters or an incorrect NULL value indicator was used; or 2) the data may exceed upper or lower bounds for table data (records). If this is the case, the contractor must contact the EPA's Project Officer to put through a change in the qc_specs program to allow the results in question to pass data table review. Some data inconsistencies may simply need to be accepted early on in the test program until enough results have been accumulated that an informed decision can be made to resolve them.

The contractor and the EPA's Project Officer and Sponsors shall audit **(review a subset of records in accordance to QAAP and QMP documents)** and report the number of unique records for the total program for each input table. The expected total number final inventory of records for this statement of work given a single LA92 per vehicle + 5% replicates is as follows:

Table name	**Primary Key**	Unique Records	Records per Vehicle	Parent Table	Parent Key Field
Equip_in.dbf	ms_id	480	1	None	None
Repar_in.dbf	ms_id	1 for every repair	0 to many	Equip_in.dbf	equip_in.ms_id
Obd_in	ms_id	1 for every OBD scan	0 to 1	Equip_in.dbf	equip_in.ms_id_id
Scan1_in	Obd_in	1 to many for vehicles with OBDI	0 to many	Obd_in	obd_in.ctr_test_id
Scan2_in	Obd_in	1 to many for vehicles with OBDII	0 to many	Obd_in	obd_in.ctr_test_id
Dynob_in.dbf	Ctr_tst_id	530	Number of Tests Per Vehicle	Equip_in.dbf	Equip_in.ms_id
Bag_in.dbf	Ctr_tst_id and bag_num	1590	Number of Tests Per Vehicle*Number of Non-Core analytes	Dynob_in.dbf	dynob_in.ctr_tst_id
Tmeas_in.dbf	Meas_id and ctr_tst_id	530	Number of Tests Per Vehicle*Number of Non-Core analytes	Dynob_in.dbf	dynob_in.ctr_tst_id
Bmeas_in.dbf	Bag_num, meas_id, and ctr_tst_id	3*The Number of Records in tmeas_in.dbf	3*Number of Tests Per Vehicle*Number of Non-Core analytes	Bag_in.dbf	dynob_in.ctr_tst_id and bag_num
Time_in.dbg	ctr_tst_id and dynosecs	761,610	1437*Number of Tests Per Vehicle	Dynob_in.dbf	dynob_in.ctr_tst_id

Rmeas_in.dbf	Ctr_tst_id, dynosecs,and meastype	The Number of records in time_in*Number of Non-Core analytes	1437*Number of Tests Per Vehicle*Number of Non-Core analytes	Time_in.dbf	dynob_in.ctr_tst_id and dynosecs
Ttime_in.dbf		Depends on Number of PEMS/PAMS units	Depends on Number of seconds in vehicle activity	Trip_in.dbf	Trip_id, ctr_tst_id and tpmeas_dt
Activity_in.dbf		Depends on Number of PEMS/PAMS units	0 to many	Equip_in	Ctr_tst_id
Trip_in.dbf		Depends on Number of PEMS/PAMS units	0 to many	Activity_in.dbf	ctr_tst_id
Fbat_in.dbf	Fbatch_id Ctr_tst_id	100	100	Fbatch	Fbatch_id and ctr_tst_id
Tpodb_in.dbf		1 for every OBD scan	0 to many	Ttime_in.dbf	Trip_id, ctr_tst_id and tpmeas_dt
Ffdat_in.dbf	Fbatch_id		0 to many	Tpobd_in.dbf	Ctr_tst_id, trip_id and tpmeas_dt
Pmeas_in.dbf	Ctr_tst_id, trip_id and tpmeas_dt		Number of seconds Per Vehicle activity *Number of Non-Core analytes	Ttime_in.dbf	Ttime_in.ctr_tst_id

The parent key field of each table must have a corresponding value in the primary key field in the parent table. Records that do not have a corresponding value in the parent table are "orphans" and can be identified with the program orphanid.prg.

Data reported on a second by second basis shall be integrated and cross-checked against any data of the same kind that is mechanically integrated using phase (bag) level techniques using the program sbschk.prg. All second by second data or phase level data that is derived from its integration shall be visually inspected for alignment and inappropriate transients (spikes and drop outs).

The EPA's Project Officer and Sponsors shall audit one in ten vehicle test data records for its own assurance of test data quality. The results of each review shall be published for the contractor's review and comment. Any error found shall be addressed as an action item between the Contractor and EPA's Project Officer. The EPA's Project Officer will inform the Sponsors and ask for their technical advice before contacting the Contractor.

5.0 TASKS

5.1 Quality Assurance Project Plan (QAPP) and Quality Management Plan (QMP) Task

The contractor shall provide a Draft QAPP **and QMP** thirty (30) days after task order issuance for review by the EPA's Project Officer and Sponsors. The contractor shall incorporate all feasible comments received before the pilot testing begins.

A final QAPP **and QMP** will be submitted within thirty (30) days of completing the pilot test program for use in both Rounds 1 and 2 of the vehicle test program. The QAPP shall conform to the EPA ANSI/ASQC E-4 standard and should have an appendix containing all applicable standard operating procedures (SOPs).

The contractor shall adhere to all applicable SOPs and the QA/QC procedures recommended therein. Applicable SOPs are available for the transportable dynamometer, sampling equipment and procedures, RSDs, and analytical chemistry. The contractor shall notify the EPA's Project Officer immediately if they encounter any equipment failures that cannot be readily remedied by the contractor, or technical problems that may impact the quality or on-time receipt of deliverables, or if any required equipment or supplies are unavailable to accomplish the required work under this task order.

5.2 Vehicle Recruitment Tasks

The contractor will provide vehicle recruitment services to the project. The contractor shall submit monthly progress reports, and conduct the tasks defined as follows:

5.2.1 Vehicle Recruitment Pilot Study

The contractor shall conduct a pilot study in KCMA to evaluate recruitment methods and incentive packages to identify the adequacy of the proposed recruitment process.

5.2.2 Cohort/Vehicle Analysis

Identify a cohort of private individuals or residences for recruitment of vehicles to the dynamometer emissions testing program in the Kansas City Metropolitan Area (KCMA). The cohort should consist of a minimum of 1,000 members who possess a minimum of 2,000 total vehicles. The cohort shall consist of a sociodemographically diverse population. The total vehicle population shall include the minimum number of vehicles required for each of the six stratum identified in Table 1 of this statement of work. **(Note: Specific guidelines have not been established on what constitutes a "diverse" population. In general, the contractor shall ensure that multiple ethnicities and socioeconomic classes are included in the project. The contractor shall also ensure the demographic data is obtained for all respondents.)** The following

subtasks shall be performed for the selected cohort.

5.2.2.a Cohort Frame Analysis

The contractor shall identify the listing(s) or frame(s) from which the cohort was recruited. The contractor shall provide, in report form, a description of the list(s) or frame(s), to cover the following topics: (1) list type and availability, i.e., publicly available, commercially available, etc.,(2) underlying sources from which the list(s) were compiled, e.g., phone directories, etc., (3) pricing (cost for obtaining information, lists, gathering and analyzing the information), (4) restrictions on availability, use or publication, and (5) any additional topic(s) that the contractor considers pertinent in the context of the PM emissions study.

5.2.2.b Cohort Recruitment (Respondent/Non-Respondent) Analysis

The contractor shall provide a description of the process through which the cohort was recruited, to cover the following topics: (1) design of the cohort, including stratification and sampling methods, (2) whether selection probabilities varied among individual members or subgroups within the cohort, based on the design, (3) the response rate achieved during the recruitment process, and whether non-response adjustments would be appropriate for analysis of data collected from the cohort, (4) availability of contact information and descriptive information for non-respondents to the cohort and (5) any additional topic(s) that the contractor considers pertinent in the context of the study. As part of this task, the contractor shall provide the EPA Project Officer with access to the vehicle registration database for the KCMA within fifteen (15) days of task order issuance.

5.2.3 Cohort/Vehicle Fleet Analysis

Compare the distribution of vehicles, by age and class, in the cohort fleet to the Kansas City metropolitan area fleet. The contractor shall determine the representativeness of the cohort fleet to the regional fleet. The contractor shall use parametric or non-parametric statistical tests to make comparisons, as appropriate. For any test applied, the contractor shall provide a retrospective estimate of the power of the test **(Note: Power refers to an analytical process used on all analyses using standard accepted techniques for the statistics used).** The contractor shall also compare the cohort and Kansas City fleets to the national fleet characteristics, as feasible.

5.2.4 Cohort/Vehicle Emission Analysis

Compare exhaust emissions of HC, NOx, and CO from the cohort fleet to the KCMA fleet. The contractor shall determine the comparability of the cohort fleet emissions distribution to the regional fleet by comparing exhaust emissions from cohort and non-cohort vehicles using remote sensing devices (RSDs) in Kansas City. The contractor shall use parametric or non-parametric statistical tests to make comparisons, as appropriate. For any test applied, the contractor shall provide a retrospective estimate of the power of the test. The contractor shall detail the data being collected and the methods of comparison.

5.2.5 Cohort/Vehicle Summary Analysis

Prepare a report that summarizes the chosen cohort for the emissions testing program, based on socio-demographic characteristics, and compares the cohort fleet, based on vehicle characteristics and emissions, to the regional and national fleets. The report shall also include the items listed in Section 3, as well as a discussion of potential sampling or non-sampling biases that may result from using the cohort as the recruitment population for the emissions testing program.

5.2.6 Vehicle Recruitment Sample Plan

Design a sampling plan for the random selection of 480 vehicles to be tested for exhaust emissions using the EPA dynamometer. For Round 1, 170 vehicles will be recruited from the cohort and 80 vehicles will be recruited from the cohort non-response families. Round 2 vehicle testing will consist of another 230 different vehicles from the cohort and 25 vehicles recruited from Round 1 for re-testing. The plan shall target a stratified sample as identified in Table 1 of this statement of work. This task shall not commence until the contractor has received written approval from the EPA's Project Officer. If use of the registration sample for recruitment will result in different costs, the contractor shall note these costs in their proposal.

5.2.7 Vehicle Recruitment

5.2.7a Vehicle Recruitment (Round 1)

The contractor shall recruit vehicles to the emissions testing program for Round 1 of the project using the sampling plans developed for Task 5. The contractor shall retain, at a minimum, the following information for all persons recruited to the program, whether they participate or not: (1) contact information, (2) location of residence, (3) any socio-demographic description information available for the residence or individual, emphasizing indicators listed in 5.2.2 above, (4) the date, time and mode of each attempted contact, and (5) the outcome of each attempted contact. This task shall not commence until the contractor has received written approval from the EPA's Project Officer.

5.2.7b Vehicle Recruitment (Round 2)

The contractor shall recruit vehicles to the emissions testing program for Round 2 of the project using the sampling plans developed for Task 5. The contractor shall retain, at a minimum, the following information for all persons recruited to the program, whether they participate or not: (1) contact information, (2) location of residence, (3) any socio-demographic description information available for the residence or individual, emphasizing indicators listed in 5.2.2 above, (4) the date, time and mode of each attempted contact, and (5) the outcome of each attempted contact. This task shall not commence until the contractor has received written approval from the EPA's Project Officer.

5.2.8 Non-Response Assessment

As part of the recruitment process, eighty (80) people who did not positively respond to the initial request to participate in the cohort will be randomly selected. These owner's vehicles will be recruited to the program to assess any potential bias in results from the recruitment of volunteers to the study. A list of non-respondent criteria will be developed with approval from EPA's Project Officer and Sponsors. The number of vehicles to target in each strata for the non-response analysis is shown in Table 3 (section 3.1.3).

5.2.9 Participation Incentives

Incentives will be required for study participants. Potential incentives include rental cars, cash, free gasoline, free vehicle repairs, and free cleanup of participant vehicles. The contractor shall develop recruitment package(s) that will achieve a high participation rate to the study from the randomly chosen subjects (both cohort participants and non-respondents, if applicable).

5.2.10 Post Round 1 Vehicle Analysis

After the completion of Round 1 vehicle testing, the contractor shall provide to the Project Officer and the Sponsors all the results (emission results (only the PM mass filter and regulated emission), data analysis, any issues, technical directions or concerns that occurred) for their review. Based on the results of Round 1 recruitment strata and/or testing procedures might need to be adjusted before the start of vehicle testing

(Round 2). The contractor shall not start Round 2 of vehicle testing without prior approval from the Project Officer.

5.3 Vehicle Testing Task

The contractor shall provide vehicle testing services to the project for the pilot and intensive field study. The contractor shall submit **monthly** progress reports, and conduct the tasks defined as follows:

5.3.1 Pilot Vehicle Testing Task

The contractor for this program will conduct a pilot test in the Kansas City area to determine and finalize all testing methodologies, quality assurance and quality control procedures, and data management procedures. For the pilot test program, three vehicles, a newer vehicle, intermediate aged and mileage vehicle and a high emitter, will be tested a minimum of three times each on an EPA fixed-site dynamometer in Ann Arbor, MI and on the transportable EPA dynamometer located in Kansas City. All vehicle testing and sample analysis procedures described in Section 3.2 and 3.3, respectively, will be conducted for the pilot test study. Within one month after completing the pilot study, the contractor shall complete a report that includes emission rates obtained for regulated pollutants and PM from any vehicles tested during the pilot study. This report shall be submitted to the EPA's Project Officer and Sponsors for use in evaluating results obtained in the pilot study. The fuel and oil used at Ann Arbor, MI testing facilities will be shipped with the vehicles for use in Kansas City. The contractor will provide a determination by conducting an experiment or series of experiments to determine if 10 hours of tunnel purging (tunnel fans on) is needed to achieve a stable tunnel operation (this pertains to tunnel wall loss or entrainment issues) or if other methods that could achieve goal but cost less.

5.3.2 Vehicle Testing Task (Specialized sampling and analytical needs)

The contractor shall complete development and implement the capability to collect and speciate gaseous and PM organic and PM inorganic samples during any field study involving the transportable dynamometer. Emission rates of these compounds using the equipment listed in Table 11 shall be reported in units of grams per mile (g/mile).

5.3.3 Vehicle Testing Task

The contractor shall provide a cost break down for both scenarios listed in section 3.2.2.1 including the following sub-tasks listed below.

5.3.3.1 Protective Covering for Equipment and Test Vehicles: The contractor shall provide protection of the testing equipment and the recruited vehicles from the elements during participation in the study **but is not required to be heated**.

5.3.3.2 Vehicle Testing and Data Collection: Vehicles scheduled for testing will be conditioned, cold soaked overnight, then tested using the cold start, LA-92. For the cold-start tests, regulated emissions will be measured over three phases of the test cycle by integrating the real-time data. Dilute exhaust bag samples for each of the three test phases and one background bag sample shall be collected from the CVS for comparison with the integrated THC measurement (FID) and for on- and off-site GC analysis. Programming of equipment and design of the experiment shall be such as to enable separate PM samples to be drawn from each of the four separate phases of the LA-92 driving schedule. All tests should be scheduled so that a minimum of five vehicles per day can be tested.

5.3.3.3 RSD Evaluation: The contractor shall evaluate exhaust emissions of the test vehicles for NOx, HCs, and CO using RSD during the conditioning process of the vehicle and/or immediately after dynamometer testing. An alternate approach is to use second by second data from the Unified Cycle emissions measured on the chassis dynamometer.

5.3.3.4 Vehicle Fluid Sampling: The contractor shall have selected vehicle's fuel and oil samples analyzed and report the results to the Project Officer and Sponsors. The contractor shall also have KCMA fuel samples analyzed and report the results to the Project Officer and Sponsors. The contractor will provide cost estimates for gathering, shipping (if any) and analysis for both fuel and oil on a per sample basis and for each methodology listed in section 3.3.2.7.

5.3.3.5 PEMS / PAMS Data: The contractor shall report data obtained in the study to EPA's Project Officer and Sponsors. Data shall be delivered in the input formats for EPA's relational database MSOD and in Excel Spreadsheets. A separate cost estimate for each round of vehicle testing will be provided on a per vehicle basis for each PEMS and PAMS measurement. A separate cost estimate will also be provided for the use of PAMS during the vehicle conditioning route on a per vehicle basis.

5.3.3.6 Reports: The contractor shall report data obtained in the study to the EPA's Project Officer using Excel spreadsheets that have been approved by the EPA's Project Officer for compatibility with their data system. If needed, the original Excel and Lotus data files can be converted to a dbf format. The contractor shall report to the EPA's Project Officer the status of equipment following its assembly in the field and prior to its use in the study.

Upon completion of the study (within two months following testing), The contractor shall submit a draft final report to the EPA's Project Officer and Sponsors detailing their work in the study. Tables will be included showing accepted and rejected vehicle IDs with OMB2060-0078 or ICR 0619.08 questionnaire information, visible smoke observations, and emission rates for regulated pollutants and PM. The draft report shall be submitted for approval by all study participants.

5.4 Speciation Tasks

5.4.1 Pilot Methods Testing Task

The contractor will review, document, and change if necessary, all procedures, methods, and sample analyses to ensure proper sampling handling and emission measurements for the testing program. The contractor shall update the QAPP to represent any changes in the procedures or methods resulting from the pilot study. The contractor will provide and prepare sampling equipment and sampling substrates required for the collection of the samples listed in Table 7 during the pilot study.

5.4.2 Source Testing Equipment Preparation Task

The contractor will provide and prepare sampling equipment and sampling substrates required for the collection of the samples listed in Table 7. The contractor will pre-test the continuous and integrated sampling equipment prior to installation at the pilot testing site to ensure proper operation and familiarity by field personnel. The contractor will provide personnel to operate the samplers and collect and store each sample.

5.4.3 Operating Continuous Measurements of Fine PM Task

The contractor will provide and operate real-time monitors for the measurement of fine particle mass and fine particle elemental carbon as shown in Table 11. The contractor shall also provide estimates of mass and

EC concentrations collected during dynamic tunnel blank sample collection to evaluate the condition of the dilution tunnel before conducting tests on the next vehicle. The contractor shall submit separate cost estimates for operating and analyzing data for each equipment type as follows:

5.4.3.1 QCM
5.4.3.2 TEOM
5.4.3.3 Nephelometer
5.4.3.4 EC

5.4.4 Integrated Sample Collection and Sample Analyses Task

The contractor shall collect samples on each vehicle tested, and conduct laboratory analyses on the number of samples as shown in Table 7.

5.4.5 Integrated Sample Analyses Task

The contractor shall perform sample analyses for integrated PM mass, EC/OC, elements, ions, SVOC's, and gaseous air toxics based on a percent of the sample estimates shown in Table 7. The contractor shall collect samples for all vehicles tested, as shown in Table 7. All samples not analyzed shall be stored in a freezer and be retained by the contractor for a period of two (2) year after completion of the task order for potential future compositional analysis. If EPA requires any samples to be analyzed **beyond what was required in this task order**, EPA will pay for shipping cost through a different contract mechanism. Two years after testing has been completed, ownership of samples revert to the contractor. The contractor shall provide cost estimates for these tasks on a per vehicle/sample basis **for the following: 1) the analysis of only fifty (50) vehicles between Rounds 1 and 2 combined; and 2)** total costs for testing all vehicles in Rounds 1 and 2 of the project. Costs for $PM_{2.5}$ mass gravimetric analysis shall be given for all vehicles only. **The contractor can propose to do composites and composite samples may be approved by the PO. Each composite sample shall be considered as one sample. Any analytical preparation costs should be included as a lump sum in this task. The contractor may want to review the literature since these compounds have been measured in previous vehicle emission studies and some are referenced in this document. The contractor needs to provide per sample and bulk sample costs to determine potential economies of scale in multiple sample analyses. If there are no cost differences, the proposed pricing should reflect this.**

The costs shall be provided based on the compounds analyzed as follows:

5.4.5.1 $PM_{2.5}$ Mass Gravimetric Analysis.

Three filter samples will be collected and analyzed for each vehicle tested. Costs for $PM_{2.5}$ mass gravimetric analysis shall be given for all vehicles only.

5.4.5.2 Elements.

One filter sample will be collected for each vehicle tested (three if the $PM_{2.5}$ mass filters are used for this analysis). The number of samples to be collected is shown in Table 7. The contractor may use the filters collected and analyzed for $PM_{2.5}$ mass for this task. The contractor will indicate their ability to measure these elements within both fuel, oil and PM samples and the sensitivity of the measurement technique(s) (e.g. 10 namograms per mile) that they propose to use. The contractor should indicate their knowledge of measurement techniques.

5.4.5.3 EC/OC.
One sample will be collected for each vehicle tested. The number of samples to be collected is shown in Table 7.

5.4.5.4 Ions.
One sample will be collected for each vehicle tested. The number of samples to be collected is shown in Table 7.

5.4.5.5 Semi-Volatile Organic Compounds.
One sample will be collected for each vehicle tested. The number of samples to be collected is shown in Table 7. The contractor shall analyze, at a minimum, the compounds listed in Table 8. The contractor should also recommend additional compounds that they believe are important for the program related to emission inventory and source apportionment profile development. **EPA recognizes that results of the project may be used to develop source apportionment profiles. Contractors may compare these profiles with previous studies.**

5.4.5.6 Gaseous Air Toxics.
One Summa canister and DNPH sample will be collected for each vehicle. The number of samples to be collected is shown in Table 7.

5.4.6 Data Analysis Task.
The contractor will compile analyzed data into a validated database that will be made available to the EPA's Project Officer. Data validation procedures will be included in the QAPP.

5.4.7 Analysis of Continuous PM and EC Data Task.
The continuous particulate measurements will be made available promptly for the relevant personnel attached to the project. The data will be provided in individual files pertaining to a given day of measurement in the case of ambient sampling, or to a particular vehicle in the case of source sampling. The data will be calibrated to an agreed upon standard of pressure and temperature. The data will be time averaged and accumulated over the entire sampling period and will be compared with filter-based measurements.

5.4.8 Maintenance of Emission Equipment Task
The contractor shall maintain, calibrate, and operate all emission equipment except the transportable dynamometer to make real-world vehicle emissions measurements in the field and laboratory. The other equipment may include but not be limited to RSDs and other PM equipment used in conducting roadside, tunnel air pollution studies and PEMS/PAMS. The contractor shall repair the equipment on an as needed basis. However, any modification of the equipment must be approved in writing by the EPA's Project Officer.

5.4.9 Health, Safety and Environmental Practices Task The contractor shall comply with all federal health and safety, environmental, waste handling, and other applicable work rules. The contractor shall also follow proper laboratory, field testing, and vehicle testing practices for all work required by this task order.

6.0 Reporting Requirement and Deliverables
The contractor shall address and report all data and technical issues required in Sections 2 through 5 of this task order. A draft final report shall be prepared and submitted electronically and in hard copy. Once the draft report is approved, the final report shall be submitted to the EPA project officer. Documents shall be prepared

using a version of Microsoft Word or comparable systems when feasible or unless otherwise specified in the task order. Electronic media materials delivered to the EPA's Project Officer and Sponsors shall be provided on 3 1/2" disks, CD-R, DVD-R or hard-drive. Copies of all written deliverables shall, to the extent possible, be double-spaced copies, and shall be delivered in reusable/recyclable envelopes. The contractor shall develop and maintain files supporting the requirements of each task.

6.1 Test Project Workplan

The contractor shall deliver to the EPA's Project Officer and Sponsors for approval that includes all descriptions, cost, responsibilities, schedules described in this document including:

- Pilot vehicle testing
- Quality assurance project plan
- Vehicle recruitment plan
- Participate in on-going communications to develop a work plan and coordinate action items and scheduling. Deliver monthly reports summarizing activities and costs.
- Report repairs needed as a result of any evaluation of the dynamometer.
- Prepare a project implementation plan within four weeks of task order approval.
- Prepare a draft final technical report of study results
- Complete a revised technical report

6.2 Other Deliverables

Other reports or meetings dealing with problems or special situations that may arise shall be requested through technical direction from EPA's Project Officer.

7.0 Meetings and Technical Direction

A kick-off meeting to discuss this Project with EPA's Project Officer and Sponsors will be held. Meetings to review data and analyses will be held on an as needed basis. The Project Officer is authorized to provide technical direction, which clarifies the Statement of Work as set forth in this task order. Before accepting any action under technical direction, the contractor shall ensure that the technical direction falls within the scope of work for this task order. Technical direction will be confirmed in writing, by the EPA's Project Officer, within five calendar days after verbal issuance. The EPA Project Officer will forward a copy to the respective Sponsors' representatives. Technical directions must be within the scope of the task order and the Statement of Work. Technical direction includes (1) direction to the contractor which assists it in accomplishing the Statement of Work, and (2) comments on and approval of reports and other deliverables. The Contracting Officer is the only person authorized to make changes to this task order. Any changes must be approved by the Contracting Officer in writing, as a modification to the task order. Upon issuance of written technical direction, the contractor shall submit for inspection copies of all work in progress at any time under this task order.

8.0 Schedule:

Final Project Workplan	**March 5, 2004**
Draft Quality Assurance Documents	**March 20, 2004**
Pilot Vehicle Testing	**April 20, 2004**
Final Quality Assurance Documents	**May 19, 2004**
Vehicle Recruitment Plan (including cohort evaluation)	**May 19, 2004**
Begin Vehicle Recruitment (Round 1)	**June 4, 2004**
Begin Vehicle Testing (Round 1)	**June 18, 2004**
End Vehicle Testing (Round 1)	**August 18, 2004**
Interim Report on Round 1	**September 18, 2004**
Begin Vehicle Recruitment (Round 2)	**January 3, 2005**
Begin Vehicle Testing (Round 2)	**January 18, 2005**
End Vehicle Testing (Round 2)	**March 30, 2005**
Draft Final Report	**June 15, 2005**
Final Report	**August 15, 2005**

If the contractor is not comfortable with the schedule listed, the contractor should propose an alternative schedule and describe their rationale for this change.

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Yanowitz et al. 2000

Appendix A.1
Mobile Source Observation Data Entry Instructions for Kansas City PM Vehicle Testing

GENERAL REQUIREMENTS: The contractor shall in general fill out the data tables completely and as best they are able using the supporting documentation and tables.. If they have questions they should contact the project officer (PO) to receive guidance. If the contractor believes the categories presented are inadequate or incorrect they shall, in consort with the PO, define new categories for the data entry. If the value is nor known or cannot be known the fields appropriate null value shall be taken from the table qc_specs.dbf.

VEHICLE/EQUIPMENT INFORMATION:

Vehicle/equipment information is data which is required by the equipment procurement data table, equip_in.dbf and shall be recorded as soon as a piece of equipment is in contractor's custody. The equip_in.dbf data table shall be delivered to the project officer along with the test data. Its fields shall be populated as follows:

- The vehicle's (not the engine's) serial number or VIN shall be entered into the field equip_in.veh_ms_id. The serial number for a piece of nonroad equipment is generally imprinted on a metal plate which is attached to the unit. It is generally preceded by "S/N" or some similar designation. The field retains its "veh" , or vehicle, designation to signify mobile source versus engine-only information within our database.

- The engine's serial number shall be entered into the field equip_in.eng_ms_id. The serial number for an engine is generally imprinted on a metal plate which is attached to the block. It is generally preceded by "S/N" or some similar designation.

- "KC_PM" shall be entered in the field equip_in.wa_id.

- The date and time of day the equipment was received into Contractor's custody shall be reported in the field equip_in.test_date and equip_in.test_tod, respectively.

- The contractor's unique test engine/equipment identifier for in-house tracking purposes shall be reported in the field equip_in.ctr_tst_id.

- An appropriate value for the site shall be selected from the table site.site and be reported in the field equip_in.site.

- The allowable values for equipment procurement methodologies to be used in this contract are located in the field procmeth.procmeth from the procmeth.dbf table. The field procmeth.procmeth_d. in this same table describes each of the allowable values. The correct value for each piece of equipment tested shall be reported in the field equip_in.procmeth.

- The value "YES" shall be recorded in the field equip_in.highway for a piece of equipment (a vehicle, truck or bus) which is intended for highway operation and "NO" for non-road equipment.

- A short description of the purpose or use of a piece of test equipment or the equipment platform from which a test engine was derived shall be recorded in the field equip_in.purpose. If this information is not known or cannot be determined, i.e, a test engine not associated with an equipment platform, the

value “NULL" shall be entered in this field.

$ “2201020110" shall be entered for the LDT1, and “2230070000" for the type 2B trucks shall be entered into the field equip_in.scc. In the case of a non-road piece of equipment an appropriate values shall be selected from the scc.scc.

$ If the equipment to be tested has an odometer at the time of procurement, the odometer’s value shall be entered into the field equip_in.proc_odom. If the equipment does not have an odometer, then the contractor shall enter “0 “ in this field.

$ The number of hours of engine operation as displayed on the engine hour meter shall be recorded in the field equip_in.hour_meter. If it is known that the engine hour meter on a particular test engine is malfunctioning or if the hours of operation cannot be determined from a direct reading of the engine hour meter, then the value “0” shall be recorded in the equip_in.hour_meter field. However, if a “good faith” estimate of the number of hours of engine operation can be obtained from the owner/operator of a particular piece of equipment, that estimate shall be rounded to the nearest 10 hours and entered into the equip_in.hour_meter field.

$ “DIES” shall be entered into the field equip_in.fueltype for equipment which is powered by diesel fuel and ”GAS” for equipment powered by gasoline.

$ The vehicle manufacturer’s name shall be selected from the field company.company from the table company.dbf and entered into the field equip_in.vehcompany.

$ The engine manufacturer’s name shall be selected from the field company.company from the table company.dbf and entered into the field equip_in.engcompany.

$ The vehicle’s nominal engine displacement in cubic inches shall be entered in the field equip_in.disp_cid. If the engine displacement is labeled in liters or cubic centimeters this field shall be reported as “0".

$ The vehicle’s engine displacement in liters shall be entered in the field equip_in.disp_liter. If the engine displacement is labeled in cubic centimeters that value shall be multiplied by 1000, and reported to the nearest tenth of a liter. If the engine displacement is labeled in cubic inches this field shall be reported as “0".

$ The allowable values for the method of fuel delivery for a vehicle are found in the field fuel_del.fuel_deliv and their description in the field fuel_del.fuel_del_d. The correct fuel delivery code for the vehicle shall be reported in the field equip_in.fuel_deliv. The vehicles in this contract will all probably have fuel injection, “FI” or carburated “CARB”.

$ The correct fuel injection method for the unit shall be reported in the field equip_in.fi_type. The allowable values to indicate the type of fuel injection are found in the field fi_type.fi_type in the fi_tytpe.dbf table and are described in the field fi_type.fi_type_d. All of the equipment procured under this contract is expected to be described as “DIRECT”, “PFI” (Port Fuel Injection), “TBI” (Throttle

Body Inject) though "INDIR" shall be used, as appropriate.

$ The allowable values to describe the process by which intake air enters the engine for combustion are found in the field aspirate.aspirated in the table aspirate.dbf and are described in the field aspirate.apirate_d. The correct value for the engine to be tested within the equipment shall be reported in the field equip_in.aspirated.

$ The number of cylinders in the engine to be tested is recorded in the field equip_in.cylinder.

$ The allowable values to describe the type of catalyst which is present on the vehicle are located in the field cat_type.cat_type in the table cat_type.dbf and are described in the field cat_type.cat_type_d. The correct value shall be reported in the field equip_in.cat_type.

$ A brief description as to the configuration of any emission control system equipment present in the test unit shall be entered into the equip_in.ecs_descpt field (up to 50 characters).

$ The allowable values to indicate that the catalyst control configuration is close loop are "YES" or "NO". It assumed that the target vehicles in this contract that all the SI vehicles shall be "YES" and all the CI vehicles shall be "NO". The appropriate value shall be reported in the field equip_in.closedloop.

$ An appropriate value indicating the vehicle class shall be selected from vehclass.vehclass and recorded in the field equip_in.vehclass.

$ The equipment's model year will be reported into the field equip_in.model_yr in the 4-digit century inclusive format. If this information is not known, the value "0" shall be entered in this field.

$ The vehicle make shall be recorded in the field equip_in.make.

$ The vehicle model name given to the vehicle by the vehicle manufacturer shall be entered into the field equip_in.model_name.

$ The equipment build date shall be recorded in the date field equip_in.v_bld_date. The format shall be MM/DD/YY. If the actual date is not reported on the equipment or in supporting literature about the particular unit, then the build date shall be reported as MM/15/YY. If the build date cannot be determined, the null date value shall be reported by leaving the field blank.

$ The engine build date shall be recorded in the date field equip_in.e_bld_date. The format shall be MM/DD/YY. If the actual date is not reported on the engine or in supporting literature about that particular engine, then the build date shall be reported as MM/15/YY. If the build date cannot be determined, the null date value shall be reported by leaving the field blank.

$ The number of fuel tanks on the piece of equipment shall be reported in the field equip_in.fueltanks. If this information is not known, the value "0" shall be entered in this field.

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- The equipment's total fuel capacity is recorded to the nearest gallon in the field equip_in.tank_cap. Fuel capacity is to be determined by the following hierarchy; labeling found directly on the physical tank(s), OEM service manual, replacement part manual(s), owner's manual, and as a last resort a drain and fill of all the unit's tank(s). If this information can not be determined, the value "0" shall be entered in this field.

- The engine exhaust emission certification family designation shall be recorded in the field equip_in.eng_fam. If this information can not be determined, the value "NULL" shall be entered in this field.

- The engine evaporative emission certification family designation shall be recorded in the field equip_in.evap_fam. If this information can not be determined, the value "NULL" shall be entered in this field.

- The allowable values for the equipment drive train description are found in the field drv_trn.dvr_trn of the table drv_trn.dbf and are described in the associated field dvr_trn.drv_trn_d. The correct value for the unit's drive train shall be reported in the field equip_in.drv_trn.. If this information is not known, the value "NULL" shall be entered in this field.

- The engine series or product line name shall be entered into the field engine.engseries. If this information is not known, the value "NULL" shall be entered in this field.

- An appropriate value for engine service class shall be selected from eng_clas.eng_class and shall be recorded in the field equip_in.eng_class. If this information is unknown or cannot be determined, the value "NULL" shall be entered in this field.

- The engine model year shall be recorded in the field equip_in.eng_mod_yr. If the actual date is not reported on the engine or in supporting literature about that particular engine, the value "0" shall be recorded in the field. In general the SI vehicle model_year shall correspond with the engine model year. That assumption may not hold however with the CI vehicles. If this information is not readily apparent leave the field blank.

- The type of aftercooling found on the engine shall be reported in the field equip_in.cooling. If the engine is not equipped with an aftercooling device, then "NONE" shall be recorded. If it is not known whether the engine has aftercooling as normally configured, the value "NULL" shall be recorded.

- The method of fuel injection shall be recorded in the field equip_in.fi_meth The allowable values for fuel injection method are found in the field fi_met.fi_meth in the table fi_meth.dbf and are described in the field fi_meth.fi_meth_d.. While most diesel engines are covered by the DI and IDI values, the contractror is encouraged to identify the fuel injection method as specifically as possible. If this information is unknown or cannot be determined for the test engine, the value "NULL" shall be entered in this field.

- The engine manufacturer-specified fuel injection pressure for the fuel injection system, if present, on the test engine shall be recorded in the field equip_in.fi_press. If this information is unknown, the value "NULL" shall be entered in this field.

- The value "YES" shall be recorded in the field equip_in.except if there is anything which is known to be or is obviously exceptional about an engine or piece of test equipment which would cause the test unit to be an outlier in most statistical analyses involving the equipment or engine. Otherwise, the value "NO" shall be recorded in the equip_in.except field.

- A brief description of the quality or qualities which would make an engine or piece of test equipment exceptional shall be entered in the field equip_in.ex_comm. This field is used in conjunction with the equip_in.except field. Otherwise, the equip_in.ex_comm field shall be left blank.

- If an engine or piece of test equipment is to be tested with a particulate trap or filter in place, then the value "YES" shall be recorded in the field equip_in.parttrap otherwise the value "NO" shall be recorded instead. If this information is unavailable or cannot be determined, then the value "NUL" shall be entered in the equip_in.parttrap field.

- The value "4" shall be recorded in the field equip_in.eng_cycl for engines with a four cycle system. The value "2" shall be recorded for engines with a two cycle system.

- The engine manufacturer's specified maximum power value (in units of brake-specific horsepower) at rated engine speed shall be recorded in the field equip_in.ratedpower. If this information is unknown or cannot be determined from the engine or in supporting literature about that particular engine, the value "0" shall be recorded in the field.

- The engine manufacturer's specified rated engine speed (in units of rpm) shall be recorded in the field equip_in.ratedspeed. If this information is unknown or cannot be determined from the engine or in the service information about that particular engine, the value "0" shall be recorded in the field.

- The engine's peak torque shall be reported in foot -pounds into the field equip_in.peaktorque.

- The engine's speed where peak torque is obtained shall be reported in rpms into the field equip_in.peakspeed.

- The engine's fuel rate at peak torque speed in lbs per hour shall be reported into the field equip_in.peakfrate.

- The engine's fuel rate at rated speed in lbs per hour shall be reported into the field equip_in.ratedfrate.

- The engine manufacturer's specified engine speed (in units of rpm) for engine idle operation shall be recorded in the field equip_in.idle_rpm. If this information is unknown or cannot be determined from the engine or in supporting literature about that particular engine, the value "0" shall be recorded in the field.

$ If the number of times that the test engine has been rebuilt is known or can be determined, that number shall be recorded in the field equip_in.rebuild_ct. If this information is unknown or cannot be determined from the engine or owner/operator, then the null value "99" shall be recorded in the field.

$ The date of the last engine rebuild shall be recorded in the field equip_in.rebuild_dt. If the last rebuild date cannot be determined or no rebuild has occurred the field shall be left blank.

$ For the last rebuild of the test engine only, if the reason that the test engine was rebuilt is known or can be determined, then that reason shall be described in the field equip_in.rebuildwhy. If the reason is unknown or cannot be determined or if the engine has never been rebuilt, then the equip_in.rebuildwhy field shall be left blank.

$ A brief description of the technical configuration and capabilities, power take-off, power "bulge", etc., of the test equipment/engine and shall be recorded in the field equip_in.tech_confg. If this information cannot be determined for the test equipment/engine or if the relevant information has already been reported elsewhere in another field , then the equip_in.tech_confg field shall be left blank.

$ A brief description of any electronic interface which may connect the equipment's speed/torque controls with an engine component which commands torque directly from the engine shall be recorded in the field equip_in.elec_cont. If this information is unknown or cannot be determined for the test equipment/engine or if the equipment has no electronic controls, then the equip_in.modifs field shall be left blank.

$ Any significant post-OEM additions or modifications made to the test equipment/engine shall be described in the field equip_in.modifs. If this information is unknown or cannot be determined for the test equipment/engine, then the equip_in.modifs field shall be left blank.

$ The allowable values to categorize a vehicle's transmission are found in the field tran_typ.tran_type. The correct value for the vehicle shall be reported in the field equip_in.tran_type.

$ The number of fuel injectors per cylinder shall be reported in the field equip_in.injectors. Typical values are as follows "0" for carbureted engines, "1" for most SI and CI engines, etc.

$ This represents what method, if any, was used to introduce supplemental air into the exhaust stream. Legal values are found and defined by AIR_INJ translation table. "NO" shall be recorded in the field equip_in.air_inj when no supplemental air was introduced. Other legal values are listed below:

"YES" - Has air injected
"PUMP" - Air injected by pump
"PULSE" - Air injected by pulse

$ The allowable values to indicate the catalyst control configuration are "YES" or "NO". The correct value for the vehicle shall be reported in the field equip_in.closedloop. If this information is not known, the value "NUL" shall be entered in this field.

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$ "SI" shall be reported for spark ignition engines and "CI" shall be reported for compression ignition in the field equip_in.ignition.

$ "NUL" shall be recorded in the field equip_in.overdrive.

$ "NUL" shall be recorded in the field equip_in.creeper.

! "NUL" shall be recorded in the field equip_in.lockup.

! "NULL" shall be reported in the field equip_in.gears.

! For the FTP test vehicles, Vehicle Curb weight, (as defined ' CFR86.082-2) is the weight of the vehicle with all fluids at their nominal (full) capacity, including fuel. The value is not the same as the equivalent test weight. There is, however, an exception for "incomplete" vehicles in the above CFR quote. A chassis destined to become a camper is an example of such a vehicle. In the case of an "incomplete" curb weight is specified by the manufacturer. The contractor shall follow the definition where it applies. In general vehicle curb weight shall be determined by weighing the vehicle and adding an estimated additional weight that would occur if the vehicle's fuel tanks were full. That value shall be reported in the field equip_in.curbweight. For computational purposes, the default weight for a gallon of gasoline fuel shall be 6.1 pounds. "999999" shall be entered into the field equip_in.curbweight for the I/M240 test vehicles.

! If the vehicle has air conditioning "YES" shall be entered into the field equip_in.ac. If the vehicle has no air conditioning, then "NO" is entered. If you do not known if the vehicle has air conditioning, "NUL" shall be entered into the field equip_in.ac.

! An appropriate value shall be selected from the field canister.canister and entered into the field equip_in.canister.

! If there is no exhaust gas recirculation, the value entered in the field equip_in.egr shall be "NO". If the engine has exhaust gas recirculation, the value shall be "YES". If its is unknown the value entered shall be "NULL".

! "NULL" shall be reported in the field equip_in.egr_type only if the equip_in.egr field contains either a "NO" or "NUL". If the engine hasexhaust gas recirculation then either "HOT" for hot air recirculation, "COOLED" for cool air recirculation shall be reported in the equip_in.egr_type.

! The gross vehicle weight rating (GVWR) shall be entered into the field equip_in.gvwr.

! The gross combined weight rating (GCWR) shall be entered into the field equip_in.gcwr.

! The field equip_in.comments shall be used to identify/explain anything a vehicle was rejected from the test program. Otherwise the fields shall be left blank.

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- The ownership of the vehicle shall be reported into the field equip_in.ownership. The legal values are either "PRIVATE" - privately owned vehicle; "RENTAL" - rented vehicle; or "GOVT" - owned by local, state, or federal government.

- Where the vehicle is stored shall be reported into the field equip_in.depot. The legal values shall be selected from the table site.site.

- The engine's NOx certification standard shall be reported into the field equip_in.cert_nox.

- The engine's PM certification standard shall be reported into the field equip_in.cert_pm.

TEST FUEL BATCHES:

Test fuel properties are stored in the fields of the table fbat_in.dbf. Each fuel batch shall if know shall have its own unique record and is populated as follows;

- The laboratory fuel batch identifier shall be recorded in field fbat_in.fbatch_id.

- If the fuel manufacture has provided the laboratory a unique identifier for the test fuel that shall be recorded in the field fbat_in.mfg_batch.

- If the test fuel is a fuel oil its centane number as measured by ASTM D 613 shall be recorded in the field fbat_in.cetane_num, otherwise "0" shall be entered into the field.

- If the test fuel is a fuel oil its centane index as measured by ASTM D 976 shall be recorded in the field fbat_in.cetane_idx. If it is not the value 0 shall be entered.

- If the centare number was increased by a "cetane improver" the amount of improvement is recorded in the field fbat_in.cetane_imp. If no cetane improver was use "0"shall be recorded in the field fbat_in.cetane_imp.

- The name of the "cetane improver", if used shall be recorded in the field fbat_in.cetane_typ. If no cetane improver was used the "NONE" shall be reported in the field fbat_in.cetane_typ.

- The concentration of sulfur in the test fuel in ppm shall be reported in the field fbat_in.sulfur.

- If an additive was used to increase the amount of sulfur in the test fuel the additive's chemical name shall be entered into the field fbat_in.sulf_agent.

- The concentration of nitrogen in the test fuel in ppm shall be reported in the field fbat_in.nitrogen. If it is not known the value "99999" shall be entered into the field.

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- The mass percent of total aromatics as measured by ASTM D 5185 shall be reported in the field fbat_in.tarom.
- The mass percent of mono-cyclic aromatics as measured by ASTM D 5185 shall be reported in the field fbat_in.marom.
- The mass percent of poly-cyclic aromatics as measured by ASTM D 5185 shall be reported in the field fbat_in.parom.
- The test fuel's distillation properties as measured with ASTM D 86 shall be entered into the appropriate fields of fbat_in.IBP, fbat_in.t10, fabatch.t50, fbat_in.t90, fbat_in.ep, fbat_in.residue, fbat_in.loss, and fbat_in.recovery.
- The test fuel's relative density as specific gravity at 60˚F shall be entered into the field fbat_in.spec_grav.
- The test fuel's relative density as Degrees API at 60˚F shall be entered into the field fbat_in.api_grav.
- The test fuel's viscosity in centistokes as measure by ASTM D 455 at 100˚F shall be entered into the field fbat_in.viscosity. If the viscosity is unknown or the fuel is a gasoline the value "0" shall be entered into the field.
- The test fuel's flashpoint in ˚F and as measured by ASTM D 93 shall be recorded in the field fbat_in.flash. If it is unknown the value "9999" shall be entered into the field.
- The test fuel's pour point in ˚F and as measured by ASTM D 97 shall be recorded in the field fbat_in.pour. If it is unknown the value "9999" shall be entered into the field.
- The test fuel's hydrogen to carbon ratio on a mole to mole basis shall be reported in the field fbat_in.hcratio. If the ratio is unknown the value "9.999" shall be entered into the field.
- The test fuel's oxygen content on a weight percent basis shall be reported in the field fbat_in.oxygen.
- The compound contributing the oxygen on the test fuel shall be reported in the field fbat_in.oxy_type. If there is no oxygen in the test fuel that "NONE" shall be reported in the field fbat_in.oxy_type.
- The weight percent of any additive package added to the fuel, other than cetane improvers, shall be reported in the field fbat_in.addditives. If the fuel is a gasoline the field shall be left blank.
- The test fuel's lubricity in grams and as measured by ASTM D 6078 shall be entered into the field fbat_in.lubric_g. If it is unknown the value "99999" shall be entered.

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- The test fuel's lubricity in millimeters of scar wear and as measured by ASTM D 6079 shall be entered into the field fbat_in.lubric_mm. If it is unknown the value "9.99" shall be entered.
- The test fuel's net heat of combustion in BTUs/pound of fuel shall be reported in the field fbat_in.heat.
- If the fuel is a diesel fuel, the test fuel's ash expressed in weight percent and as measured by ASTM D 482 shall be reported in the field fbat_in.ash.
- "0" shall be recorded in the field fbat_in.mon and fbat_in.ron fi the fuel is a diesel fuel. If the fuel is a gasoline the motor octane will be entered in the former and the research octane shall be entered in the latter.
- If the fuel is a gasoline the its RVP shall be recorded in the field fbat_in.rvp. If it is a diesel fuel the value "99.9" shall be entered.
- The grams of carbon per pound of test fuel in dry air shall be reported in the field fbat_in.fen_c.
- The weight fraction carbon of the test fuel shall be reported in the field fbat_in.wgt_fractn.
- The aromatic content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_aroma.
- The olefin content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_olefn.
- The saturate content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_sat.
- If the test fuel is the certification gasoline "60" shall be reported in the field fbat_in.fuel_id. If the test fuel is the certification diesel fuel "96" shall be reported in the field fbat_in.fuel_id. If the fuel is tank fuel the field dyno_in.fuel_id shall be "0".
- "KC_PM" shall be entered in the field equip_in.wa_id.
- The cloud measurement of the test fuel shall be reportin the field fbat_in.cloud.

FTP LABORATORY TESTING: The FTP shall be run as a three phase test. The laboratory test level information shall be reported in the table structure headed by dyno_in.dbf for laboratory values and are to be populated for the tests as follows:

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- The laboratory test identifier shall be recorded in field dyno_in.ctr_tst_id.
- "FTP" shall be reported in the field dyno_in.test_proc.
- "KC_PM" shall be entered into the field dyno_in.wa_id.
- "FTP" shall be reported in the field dyno_in.sched_id.
- The initial FTP shall have the value .F. entered into the field dyno_in.replicate. The second FTP for the test vehicles shall have the value .T. entered into the field dyno_in.replicate.
- If the test fuel is the certification gasoline "60" shall be reported in the field dyno_in.fuel_id. If the test fuel is the certification diesel fuel "96" shall be reported in the field dyno_in.fuel_id. If the fuel is tank fuel the field dyno_in.fuel_id shall be "0".
- The value entered into equip_in.veh_ms_id for this vehicle shall be reported in the field dyno_in.ms_id.
- The test date and time of day shall be reported into the fields dyno_in.test_date and dyno_in.test_tod respectively following the format specified for them.
- "ANNARBOR" shall be reported in the field dyno_in.site if tests were performed in Michigan. If test were performed in Kansas City then "KANSASCITY " shall be reported.
- 75 ˚F shall be reported in the field dyno_in.nom_temp.
- 50 grains of water per pound of dry air at 60 ˚F shall be reported in the field dyno_in.nom_humid.
- "0" shall be entered into the field dyno_in.disable.
- FTP composite emissions (' 86.144-90) for THC, CO, NOx, and CO2 shall be reported in the fields dyno_in.thc, dyno_in.co, dyno_in.co2, and dyno_in.nox.
- FTP composite fuel economy in miles per gallon shall be entered into the field dyno_in.mpg.
- The vehicle's ETW shall be entered into the field dyno_in.testwght.
- The dynamometer's indicated road load horse power at 50 miles per hour shall be entered into the field dyno_in.road_hp.
- "NO" shall be entered into the field dyno_in.ac_hp.

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- An appropriate value shall be selected from the dynotype.dynotype and shall be entered into the field dyno_in.dynotype.
- The vehicle's odometer reading at the start of the test shall be entered into the field dyno_in.odometer.
- The appropriate value to represent the tests preconditioning be selected from the field precond.precond and shall be reported in the field dyno_in.precond.
- The ambient temperature in degrees F at the start of the test shall reported in the field dyno_in.int_temp.
- The barometric pressure in inches of mercury at the start of the test shall be entered into the field dyno_in.init_baro.
- The humidity in grains of water per pound of dry air at the start of the test shall entered into the field dyno_in.init_humid.

The field dynob_in.resultgrp shall be left blank.

FTP composite emissions (' 86.144-90) for methane shall be reported in the table format tmeas_in.dbf. The fields shall be populated as follows:

- "METHANE" shall be reported as tmeas_in.meas_id if being measured.
- The laboratory test id shall be reported in the field tmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.
- The composite methane emissions in grams per mile shall be reported in the field tmeas_in.measure.

FTP dynamometer brake horse power hours shall be reported in the table format tmeas_in.dbf. The fields shall be populated as follows:

- "BHPH" shall be reported as tmeas_in.meas_id.
- The laboratory test id shall be reported in the field tmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.
- The amount of work performed by the vehicle ,as measured by the dynamometer for the entire test shall be reported in the field tmeas_in.measure in units of brake horsepower hours.

For SI vehicles the test level total particulate ('86.110-90) shall be reported in the table format tmeas_in.dbf. The fields shall be populated as follows:

- "PMT_CFR110" shall be reported as tmeas_in.meas_id.
- The laboratory test id shall be reported in the field tmeas_in.ctr_tst_id and the same as that in dynob_in.ctr_tst_id.
- Test level emissions in milligrams per mile for the particulate emissions shall be reported in the field tmeas_in.measure.

Bag (phase) level test data shall be reported for laboratory values in the table format bag_in.dbf where the fields shall be populated as follows:

- The bag (phase) number, "1" , "2" or "3" shall be reported in the field bag_in.bag_num.
- The laboratory test id used for the test level information shall be reported in bag_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.
- The average barometric pressure in inches of mercury shall be reported in the field bag_in.bag_baro.
- The average test cell temperature in degrees F shall be reported in the field bag_in.bag_temp.
- The average test cell humidity in grains of water per pound of dry air at 60 ˚F shall be reported in the field bag_in.bag_humid.
- The total simulated distance traveled by the vehicle per phase in miles shall be reported in the field bag_in.bag_dist.
- Total hydrocarbon shall be reported as grams per mile in the field bag_in.bag_thc.
- Carbon monoxide shall be reported as grams per mile in the field bag_in.bag_co.
- Carbon dioxide shall be reported as grams per mile in the field bag_in.bag_co2.
- Oxides of nitrogen shall be reported as grams per mile in the field bag_in.bag_nox.
- The vehicle's fuel consumption in miles per gallon per phase shall be reported in the field bag_in.bag_mpg.

The phase (bag) level methane emissions shall be reported in the table format bmeas_in.dbf. The fields shall be populated as follows:

- The phase (bag) number shall be reported in the field bmeas_in.bag_num.

- "METHANE" shall be reported as bmeas_in.meas_id if measured.

- The laboratory test id shall be reported in the field bmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The phase (bag) methane emissions in grams per mile shall be reported in the field bmeas_in.measure.

The phase (bag) level amount of work exerted by the dyno in brake horsepower hour emissions shall be reported in the table format bmeas_in.dbf. The fields shall be populated as follows:

- The phase (bag) number shall be reported in the field bmeas_in.bag_num.

- "BHPH" shall be reported as bmeas_in.meas_id.

- The laboratory test id shall be reported in the field bmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The phase (bag) work performed by the dynamometer in brake horsepower hour shall be reported in the field bmeas_in.measure.

For SI vehicles the phase (bag) level total particulate ('86.110-90) shall be reported in the table format bmeas_in.dbf. The fields shall be populated as follows:

- The phase (bag) number shall be reported in the field bmeas_in.bag_num.

- "PMT_CFR110" shall be reported as bmeas_in.meas_id.

- The laboratory test id shall be reported in the field bmeas_in.ctr_tst_id and the same as that in dynob_in.ctr_tst_id.

- Test level emissions in milligrams per mile for the particulate emissions shall be reported in the field bmeas_in.measure.

Second by second emission data for the laboratory test measurement shall be reported in the table format time_in.dbf where the fields shall be populated as follows:

- The accumulated test time in seconds shall be reported in the field time_in.dynosecs.

- The laboratory test id shall be reported in the field time_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

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- The average speed for the measured unit of time (1 second) shall be reported in miles per hour in the field time_in.speed.
- The simulated distance traveled by the vehicle for the measured unit of time (1 second) in miles shall be reported in the field time_in.dist.
- Total hydrocarbon for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_thc.
- Carbon monoxide for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_co.
- Oxides of nitrogen for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_nox.
- Carbon dioxide for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_co2.
- Total hydrocarbon accumulated to this time in grams shall be reported in the field time_in.w_thc.
- Carbon monoxide accumulated to this time in grams shall be reported in the field time_in.w_co.
- Oxides of nitrogen accumulated to this time in grams shall be reported in the field time_in.w_nox.
- Carbon dioxide accumulated to this time in grams shall be reported in the field time_in.w_co2.
- The phase number shall be reported in the field time_in.test_phase.

The second by second level amount of work exerted by the dyno in brake horsepower hour emissions shall be reported in the table format rmeas_in.dbf. The fields shall be populated as follows:

- The accumulated test time in seconds shall be reported in the field rmeas_in.dynosecs.
- "BHPH" shall be reported as rmeas_in.meas_id.
- The laboratory test id shall be reported in the field rmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.
- The phase (bag) work performed by the dynamometer in brake horsepower hour shall be reported in the field bmeas_in.rep_meas.

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FTP PEMS TESTING:
The test level information shall be reported in the table format road_in.dbf for PEMS values and are to populated for the as follows:

- The laboratory test identifier shall be recorded in field road_in.ctr_tst_id. This must be different from that used in the laboratory delivery tables and unique overall.
- "DROVE" shall be reported in the field road_in.test_proc.
- "KC_PM" shall be entered into the field road_in.wa_id.
- The initial FTP shall have the value .F. entered into the field road_in.replicate. The second FTP for the test vehicles shall have the value .T. entered into the field road_in.replicate.
- The same value use to populate the field dynob_in.fuel shall be used to populate the field road_in.fuel.
- The value entered into equip_in.veh_ms_id for this vehicle shall be reported in the field road_in.ms_id
- The test date and time of day shall be reported into the fields road_in.test_date and road_in.test_tod respectively.
- "0" shall be entered into the field road_in.disable.
- AFTP" shall be reported in the field road_in.route.
- A unique identifier for the specific version and model of SEMTECH shall be entered into the field road_in.instrsys.
- The vehicle's ETW shall be entered into the field road_in.actweight.
- The average ambient temperature in degrees F shall be reported in the field road_in.avg_temp.
- The average humidity in of water per pound of dry air at 60 ˚F shall be reported in the field road_in.avg_humid.
- The average barometric pressure in inches of mercury shall be reported in the field road_in.avg_baro.
- The vehicle's odometer reading at the start of the test shall be entered into the field road_in.odometer.
- The appropriate value, selected from precond.precond, to represent the tests preconditioning shall be reported in the table road_in.precond.

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- Total test time in minutes, including the ten minute soak shall be entered into the field road_in.timeonroad.
- The total test distance in miles for the FTP shall be entered in to the field road_in.distance.
- The total work performed by the engine. calculated by SEMTECH, and in brake horsepower hours shall be entered into the field road_in.totalwork.
- "0" shall be entered into the field road_in.gallons.
- The phase emissions in grams for THC shall be reported in the field road_in.w_thc.
- The phase emissions in grams for CO shall be reported in the field road_in.w_co.
- The phase emissions in grams for CO_2 shall be reported as in the field road_in.w_co2.
- The phase emissions in grams for O_2 shall be reported as in the field road_in.w_o2.
- The phase emissions in grams for NO_x shall be reported as in the field road_in.w_no.

Bag (phase) level test data shall be reported for SEMTECH values in the table format phase_in.dbf where the fields shall be populated as follows:

- The laboratory test identifier shall be recorded in field phase_in.ctr_tst_id and the same as that in road_in.ctr_tst_id.
- The bag (phase) number, "1" , A2" or A3" shall be entered into the field phase_in.phase_no.
- The average ambient temperature in degrees F shall be reported in the field phase_in.avg_temp.
- The average humidity in of water per pound of dry air at 60 ˚F shall be reported in the field phase_in.avg_humid.
- The average barometric pressure in inches of mercury shall be reported in the field phase_in.avg_baro.
- Total test time in minutes, including the ten minute soak shall be entered into the field phase_in.timeonroad.
- The total test distance in miles for the FTP shall be entered in to the field phase_in.distance.
- The total work performed by the engine, as calculated by SEMTECH, and in brake horsepower hour shall be entered into the field phase_in.totalwork.

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- The gallons of fuels for this phase shall be entered into the field phase_in.gallons.
- The phase emissions in grams for THC shall be reported in the field phase_in.w_thc.
- The phase emissions in grams for CO shall be reported in the field phase_in.w_co.
- The phase emissions in grams for CO_2 shall be reported as in the field phase_in.w_co2.
- The phase emissions in grams for O_2 shall be reported as in the field phase_in.w_o2.
- The phase emissions in grams for NO_x shall be reported as in the field phase_in.w_no.
- The start emissions shall be reported as "YES" in the field phase_in.start_emis for phase 1 and 3. The start emissions shall be reported as "NO" in the field phase_in.start_emis for phase 2.
- AAMBT" shall be reported in the field phase_in.veh_state for phase 1, AOPERA" shall be reported in the field phase_in.veh_state for phase 2, and ATRANS" shall be reported in the field phase_in.veh_state for phase 3.

Second by second emission data for the SEMTECH shall be reported in the table format rtime_in.dbf where the fields shall be populated as follows:

- The laboratory test id shall be reported in the field rtime_in.ctr_tst_id and the same as that in road_in.ctr_tst_id.
- The accumulated test time in seconds shall be reported in the field rtime_in.roadsecs.
- The phase number shall be reported in the field rtime_in.phase_no.
- The average vehicle speed for the measured unit of time (1 second) shall be reported in miles per hour in the field rtime_in.roadspeed.
- The average engine vehicle speed for the measured unit of time (1 second) shall be reported in rpm in the field rtime_in.enginerpm.
- The average engine torque for the measured unit of time (1 second) shall be reported in foot pounds in the field rtime_in.roadtorque.
- The average ambient temperature for the measured unit of time (1 second) shall be reported in degrees F in the field rtime_in.roadtemp.

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- Total hydrocarbon for the measured unit of time (1 second) shall be reported in grams per second in the field rtime_in.r_thc.

- Carbon monoxide for the measured unit of time (1 second) shall be reported in grams per second in the field rtime_in.r_co.

- Oxides of Nitrogen for the measured unit of time (1 second) shall be reported in grams per second in the field rtime_in.r_no.

- Carbon dioxide for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_co2.

- Oxygen for the measured unit of time (1 second) shall be reported in grams per second in the field rtime_in.r_o2.

LA92 - LABORATORY TESTING: The LA92 shall be run as a three phase test. The test level information shall be reported as the same as the FTP data in the table format dyno_in.dbf for laboratory values except that;

- "LA92" shall be reported in the field dyno_in.test_proc.

- The appropriate value for the preconditioning, "505HS", "LA4" or "FTP", shall be reported in the field dyno_in.precond depending on if any preconditioning was performed to keep the vehicle "fully warmed."

- The LA92 is a three phase (bag) test with physical bags, therefore the test level emissions and the phase (bag) level emissions for THC, CO, NOx, and CO_2 are equivalent and shall be reported the same in dyno_in.dbf and bag_in.dbf respectively. "1, 2 or 3" shall be reported in the field bag_in.bag_num.

- Second-by-second data shall be reported the same as for an FTP.

LA92 - SEMTECH TESTING:
The test level information shall be reported in the table format road_in.dbf for SEMTECH values and are same as the FTP data except that;

- "LA92" shall be reported in the field road_in.route.

- The total test distance in miles for the LA92 shall be entered in to the field road_in.distance.

- The road_in.gallons value shall be the same value entered into the field phase_in.gallons.

- LA92 emissions in grams for THC in the field road_in.w_thc shall be reported the same as the emissions reported in phase_in.w_thc.
- LA92 emissions in grams for CO in the field road_in.w_co shall be reported the same as the emissions reported in phase_in.w_co.
- LA92 emissions in grams for CO_2 in the field road_in.w_co2 shall be reported the same as the emissions reported in phase_in.w_co2.
- LA92 emissions in grams for O_2 in the field road_in.w_o2 shall be reported the same as the emissions reported in phase_in.w_o2.
- LA92 emissions in grams for NOx in the field road_in.w_no shall be reported the same as the emissions reported in phase_in.w_no.

The bag(phase) level test data shall be reported in the table format phase_in.dbf for SEMTECH values and are same as the FTP data except that;

- The bag (phase) number shall be "1" shall be reported in the field phase_in.bag_num.
- The start emissions shall be reported as "NO" in the field phase_in.start_emis.
- "OPERA" shall be reported in the field phase_in.veh_state.

SEMTECH FIELD DATA

The field data for all the light duty vehicles are recorded and the same manner as in the laboratory. To capture the length of time the vehicle is sampled the table actty_in.dbf is populated in the following manner;

- The sampling period shall be identified by the contractor by a unique character string in the field actty_in.ctr_tst_id.
- "KC_PM" shall be entered into the field actty_in.wa_id.
- The value entered in equip_in.veh_ms_id for this vehicle is entered into the field actty_in.ms_id
- The date and time of the installation is entered into the field actty_in.install_dt.

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- If the vehicle has an hour meter it's value shall be entered into the field actty_in.install_hrm.
- If this vehicle has been sampled before under the same procurement the field actty_in.replicate shall be >.T.'. Otherwise the field shall be marked as >.F.'
- If the odometer reading at the time of the installation shall be entered into the field actty_in.instal_odm.
- At the end of the sample period the data and time shall be entered into the field actty_in.unstall_dt, the odometer reading inactty_in.unstal_odm, and the hour meter reader in the the fieldactty_in.unstl_hrm.

The sample shall capture the concept of trips, which are periods between engine on and engine off where the engine is running. That data shall be captured in the table trip_in.dbf and populated as follows;

- A unique identifier for each trip shall be entered into the field trip_in.ctr_tst_id.
- The value of the trips associated sample with the shall be captured by recording its actty_in.ctr_tst_id in trip_in.activityid.
- A gross fuel identifier that is appropriate from the fuel.fuel_id shall be entered into the field trip_in.fuel_id.
- If fuel analysis information is available the fuel batch identifier for the fuel analysis data captured in the table fbat_in.dbf is entered into the field trip_in.fbatch_id.
- The date and time of the beginning of the trip shall be recorded in the field trip_in.tstart_dt.
- The date and time of the end of the trip shall be recorded in the field trip_in.tend_dt.
- A unique identifier of the vehicle operator shall be entered into the field trip_in.operatortp.
- Any change in the instrument configuration done for this trip shall be done so with a unique instrument configuration character string in the field trip_in.ins_config.
- An estimate of vehicle load in passengers in the case of motor vehicle shall be recorded in the field trip_in.passengers.
- An estimate of the vehicle's payload including passengers and cargo shall be estimated to the nearest pound in the fiel trip_in.payload.

The second by second data shall be captured in the table rtime_in.dbf and shall be populated as follows;

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- The value of the trip_in.ctr_tst_id shall be entered into the field rtime_in.ctr_tst_id.
- The value of the trips associated sample shall be captured by recording its rtime_in.ctr_tst_id in trip_in.activityid.
- The running sequential time in seconds shall be recorded in the field rtime_in.trip_secs.
- The one second average vehicle speed in miles per hour for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_speed.
- The one second average engine speed in rpm for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_rpm.
- The one second average engine torque in foot pounds for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_torq.
- The one second average engine torque in foot pounds for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_torq.
- The one second average ambient air temperature in degrees F for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_tempf.
- The one second average ambient air temperature in degrees C for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_temp.
- The one second average barometer in inches of mercury for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_baro.
- The one second average barometer in kPa for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.inst_baro.
- The one second average humidity in grains of water per pound of dry air for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_humid.
- The one second average latitude in degrees for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_lat.
- The one second average longitude in degrees for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_long.
- The one second average altitude in feet for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_alt.

Appendix A.1
Mobile Source Observation Data Entry Instructions
for Kansas City PM Vehicle Testing

- The one second average grade in percent for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_grade.
- The one second average mass air flow thru the vehicle's engine in standard cubic feet per second for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.trip_massf.
- The one second engine fuel rate in pounds per second for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.fuel_rate.
- The one second thc, co, nox, and oxygen emission in grams for the associated rtime_in.trip_secs shall be recorded in the fields rtime_in.trip_thc, rtime_in.trip_co, rtime_in.trip_co2, rtime_in.trip_nox, and rtime_in.trip_o2.
- The one second engine coolant temperature in degrees F for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.eng_cool.
- The one second engine oil temperature in degrees F for the associated rtime_in.trip_secs shall be recorded in the field rtime_in.eng_oil.

Non-core measurements at the second-by second level are recorded in the table pmeas_in.dbf. They are recorded by entering into each record;

- The value of the trip_in.ctr_tst_id shall be entered into the field pmeas_in.ctr_tst_id.
- The value of the trips associated sample shall be captured by recording its pmeas_in.ctr_tst_id in trip_in.activityid.
- The running sequential time in seconds shall be recorded in the field pmeas_in.trip_secs.

The associated value for pmeas_in.meas_id for the various analytes measured on a second by second basis are found in the attached table;

Measurement	meas_id	Units
AC Compressor On or off	ac_on_off	None
AC Load	ac_load	watts
Throttle Position	throttle_p	percent
Exhaust Temperature (degrees F)	exh_temp	Degrees F

Appendix A.1
Mobile Source Observation Data Entry Instructions
for Kansas City PM Vehicle Testing

Intake Manifold Pressure	intake_mfp	Inches of Mercury
Transmission Gear	trans_gear	None

The measurements themselves shall be stored in the field pmeas_in.meas_value. The ac compressor status shall be characterizes as “0” as off and “1” as on. The transmission gear shall be characterized by -1 for reverse, 0 for neutral, 1, 2,3 etc for forward gears.

Appendix B Sample Size Estimation

As mentioned in the proposal, the sample size was derived in three steps, as described below.

1. *Estimate initial sample size* (n_{SRS}). The initial sample size was calculated under the following assumptions:

- The sample will be large enough that large sample theory applies, i.e., the sampling distribution of the mean(s) will be approximately normal.
- Vehicles would be drawn from the population using simple random sampling (SRS).
- The objective is to estimate the fleet average PM emissions rate (g/mi), to within 20% margin of error (E) at a 95% level of confidence (associated t-statistic is 1.96).
- The population variance is estimated by a coefficient of variation (CV) of 250%. This value is intended to be conservative, adopted from a study in Denver that included winter as well as summer measurements in a sample heavily weighted towards older vehicles.

The initial estimate is thus calculated as:

$$n_{SRS} = \frac{CV^2 \cdot t^2}{E^2} = \frac{2.5^2 \cdot 1.96^2}{0.20^2} = 600 \text{ vehicles}$$

1. *Estimate the effective sample size* (n_{strat}). The effective sample size reflects the expected gain in precision from use of the age-by-vehicle-class stratification. It is calculated as

$$n_{strat} = n_{SRS} \cdot \text{deff}, \text{ where}$$

$$\text{deff} = \frac{s^2_{mean,\,strat}}{s^2_{mean,\,SRS}} = \frac{0.7000}{0.9014} = 0.78$$

This result suggests that the proposed stratified sampling should allow us to achieve the stated precision objective with ~20% fewer vehicles than we would expect using SRS, i.e., with 480 as opposed to 600 vehicles. The "design effect" (deff) represents the reduction in the variance of the mean achieved through stratification. Note that variances in the equation are the estimated variances of the *sampling distribution of the mean*, not the population variance. For this analysis, the estimated variances were calculated using a set of data collected in the SCAQMD (Norbeck et al. 1998). The data used represent a subset of vehicles identified as "normal" emitters, as these vehicles were recruited randomly in the context of the NCHRP. Thus, we assume that these vehicles give a rough indication of the relative sizes of the age-class and vehicle-class strata, as defined in Tables 1 and 2 below.

Our estimated variance of the mean under SRS assumptions is simply the estimated population variance divided by the total sample size, or

$$s^2_{\text{mean, SRS}} = \frac{s^2_{\text{SRS}}}{n}$$

where the estimated population variance is calculated using the available data but disregarding the age classes under which it was collected. We estimate variance of the mean under stratification ($s^2_{\text{mean,strat}}$) by calculating a weighted variance from the variances of the mean in each stratum h ($s^2_{\text{mean},h}$), as follows (Kish, 1965)[1]:

$$s^2_{mean,strat} = \sum_{h=1}^{6} W_h^2 \left(\frac{s_h^2}{n_h} \right) = \sum_{h=1}^{6} W_h^2 \cdot s^2_{\text{mean},h}$$

The stratum weight W_h is intended to serve as an estimate of the relative size of the stratum, and is this case was calculated as number of observations in each stratum from the SCAQMD dataset, here denoted as m_h.

$$W_h = \frac{m_h}{\sum_{h=1}^{6} m_h}$$

2. *Allocate the Effective Sample among Strata.* To divide the proposed sample among the six strata, again using the observations from the SCAQMD data (m_h) as a guide. We have used Neyman allocation, which assigns sub-samples based on the product of the stratum size m_h and stratum standard deviation s_h. This allocation is designed to optimize the resulting precision for the given total sample size. The optimal sample within each stratum $n_{h,\text{opt}}$ is given as

$$n_{h,\text{opt}} = n_{\text{strat}} \left(\frac{s_h m_h}{\sum_{h=1}^{6} s_h m_h} \right)$$

[1] Kish, L. (1965). *Survey Sampling*. John Wiley & Sons, New York.

Finally, the raw optimal stratum samples were rounded and adjusted slightly to reduce larger differences between strata given by the optimization. Final adjusted stratum samples are denoted as $n_{h,\text{adj}}$ and presented in Table 2.

Table 1. Definition of Strata by Vehicle and Age Class

Stratum (*h*)	Vehicle Class	Age Class[3]
1	Truck[1]	Pre 1981
2	Truck	1981-1990[4]
3	Truck	1991 and newer
4	Car[2]	Pre 1981
5	Car	1981-1990[4]
6	Car	1991 and newer

[1] Includes LDGT1 and LDGT2 vehicle classes.
[2] Includes LDGV vehicle classes.
[3] Following Norbeck et al. (1998) and Cadle et al. (1999).
[4] Authors designated two strata, 1981-85 and 1986-90. These were collapsed, due to a close similarity in mean PM rates.

Table 2 Estimated Sample Size and Allocation Among Age and Vehicle-Class Strata

Stratum	m_h	mean	Variance (s^2_h)	Std. Dev. (s_h)	CV	Var(mean) ($s^2_{\text{mean},h}$)	SE ($s_{\text{mean},h}$)	W_h	$n_{h,\text{opt}}$	Allocation $n_{h,\text{adj}}$	$n_{h,\text{adj}}$ (%)
1	2	30.34	556.95	26.30	0.78	278.48	16.69	0.0222	40.52	50	10.4
2	15	9.30	165.66	12	1.	11	3.32	0.167	165.78	140	29

				.87	.38	.04				.2
3	22	3.15	9.59	.10	.98	.44	0.66	0.244	58.50	70	14.6
4	2	25.00	482.34	21.96	.88	241.17	15.53	0.0222	37.72	40	8.3
5	15	3.22	10.56	.25	1.01	.70	0.84	0.167	41.86	50	10.4
6	34	1.93	21.58	4.65	2.41	.63	0.80	0.378	135.62	130	27.1
Total	**90**									**480**	

Notation:

Std. Dev. = Standard Deviation
CV = Coefficient of variation, defined as Std. Dev./mean.
Var(mean) = Variance of the sampling distribution of the mean, = variance/n for each stratum.
SE = Standard Error of the mean, defined as SE/$\sqrt{n}$.
W = stratum weight, defined as $n/\Sigma n$, for each stratum.
$n_{h,opt}$ = raw sub-sample in each stratum as assigned by Neyman allocation.
$n_{h,adj}$ = rounded sub-sample in each stratum.

Appendice D - OTAG's Government Furnished Property List

Instrument	Manufacturer	EPA ID	S/N	Cost
Diesel Particulate Monitor (DPM), Model 1105A	Rupprecht & Pataschnick Co., Inc.	792787	1105A201479907	$39,647 with computer
DPM Computer and Monitor	?	792787-2 792787-3	032333021 H051J7000434	See DPM
Dewpoint Generator, Model DG-1, Plus auxiliary Equipment: Hot Plate, Model 1103	Sable Systems, Inc.	n/a	DG0101-03	$4,290
Dewpoint Monitor, Model M170	Jenway	n/a	1248	$ 895
	Visala	n/a	X3550014	$2,495
Real Time Particulate Mass Monitor, Model RPM-101	Booker Systems, Ltd.	n/a yet	n/a	$53,000
DataRam 4000	Thermo- MIE Inc.	793003	D055	$10,550
Portable Emission Measurement Systems (PEMS)	Sensors, Inc. Semtech - D - 2 Semtech - G - 6	n/a yet		$25,000 - $40,000 depending on model type

Three Light-Duty Vehicles for Round Robin Testing	Various Manufacturers	n/a yet		$5,000 - $20,000 depending on model
Portable Activity Measurement Systems (PAMS)	approximately 10 units	n/a yet		$300 per unit
Auxiliaries				
KT1 Plus Compressor	Kaeser	n/a	n/a	$2,500
Heated Sample Valve System	Burkert	n/a	n/a	$4,500
Valve Control System	EPA	n/a	n/a	$1,200
Heated Lines and Controllers	Unique Products	n/a	n/a	$12,000

n/a - Not Assigned

Appenidces D - ORD's Government Furnished Property (Dynamometer and Other Equipment)

Item	Manufacturer	Model #	Serial (ID) #	EPA #
Trailer	Haulmark	G816B3-102	4XSGB1629Y G022365	
Instrument rack, (42"x71"x28")				
CO2 Instrument	Horiba	AIA-210	569687041	911710
CO(H) Instrument	Horiba	AIA-210	56884301	911711
Nox Instrument	Horiba	CLA220	573834033	969210
Hydrocarbon Instrument	Horiba	FIA236	850624012	
Hydrocarbon Instrument	Horiba	FIA34A	850584012	
Hydrocarbon Instrument	Horiba	OPE435	850658077	
CO Instrument, optical	Horiba	AIA23AS	850988014	
CO Instrument, electronics	Horiba	OPE135	850658014	
Digital Meter	LFE			

Meter, temperature	Omega	DP205TC		
Meter, temperature	Omega	DP205TC	3081342	
Meter, temperature	Omega	DP205TC	3081329	
2 Meters, digital	Newport	2AP2		
Meter, digital	Cole-Parmer	7350-38	17524-17-1287	
Pressure Transducer	Data Instruments	SA	3488-0017	
Temperature Controller	Unique Products	223-1531	6336	
Temperature Controller	Unique Products	223-1531		
Computer	Mitsuba	1239933	n/a	928752
Monitor	Dell	D1028L	66746JA56K	
Computer mouse	Kentronix		10017631	
Printer	Hewitt Packard	Deskjet 932C	NX0C61SOHZ	
Keyboard	Chicony	KB5181	TCK3C08137	
Monitor	Axion	CL-1566	CB266AS00744	
Instrument Rack (24"x24"x74")				

Heated Line	Unique Products		S11B4240TM AA1	
Temperature Controller	Unique Products	223-1531	4878	
Temperature Controller	Unique Products			
Refrigerator	Whirlpool	EL05CCXJW	EE0218193	
Chair				
Chair				
VGA distribution amplifier	Extron	P/2 DA2 Plus	249005	
Headphones	David Clark Co.	H5030	12511G-01	
Headphones	David Clark Co.	H5040	16298G-03	
Headphones	David Clark Co.	H5030		
Readout box	Tylan	RO32	FP901021	
Mass Flow Controller	Tylan	FC280	AW801070	
Instrument Rack (74"x24"x24")				
Monitor	Mitsuba	CM43	353JR000U00644	

Drivers Aid	Horiba SADA 2040	270188	9443501	911694
Computer	Hewlett Packard	VL2	3436A00341	
Digital Readout box	Tylan	RO28	F0604019	
Mass Flow Controller	Tylan	FC280	AW801200	
Mass Flow Controller	Tylan	FC280	AW801201	
Mass Flow Controller	Tylan	FC280	AW805124	
Mass Flow Controller	Tylan	FC280	AW507001	
Keyboard	Qtronix	QX901	903000755	
Rack Power Strip	Flexiduct	BR06010	NXX300120	
Rack Power Strip	Flexiduct	SP12410	BXX300022	
Instrument manuals in 3-ring binder				
Winch, electric	Dayton	4Z327A		
Regulator, gas	National Welders	3104C		

Regulator, gas	National Welders	HPT270C	A217254	
Regulator, gas	National Welders	HPT270-125-590-DK		
Regulator, gas	National Welders	HPT2700	E227323	
Regulator, gas	Nox 660			
Regulator, gas	National Welders	HPT272C	KY37784	
Regulator, gas	National Welders	GPT2700	GA33049	
Regulator, gas	National Welders	HPT270C	FZ13512	
Bag Rack w/ 8 Tedlar bags	Horiba			
Air Pump	Metal Bellows	MB-21	10545	
Air Pump	Thomas	1107CM75	0000187	
Air Pump	Gast	0523-V191Q-G582DX	9802803610	
Air Pump	Gast	0523-V191Q-G582DX	9812011058	
Air Pump	Gast	0523-V191Q-G588DX	1002119130	

Air Pump	Thomas	607CA22		
Air Pump	Thomas	607CA22		
Air Pump	Thomas	607CA22		
Relay and Solenoid Rack				
Temperature Controller	Unique Products	223-2219	13202	
Temperature Controller	Unique Products	223-2219J	7813	
Temperature Controller	Unique Products	223-1531	4748	
Heated Line, 20' x 1/4 “	Unique Products			
Heated Line, 20' x 1/4"	Unique Products			
Heated Line, 20' x 1/4"	Unique Products			
Heated Line, 50' x 3/8"	Unique Products			
Heated Filter	Unique Products	FLT1584BB6 AAJ-000	13203	
Heated Filter (on order)				

Cyclone, ss (on order)	URG			
Cyclone, ss (on order)	URG			
(2) Power Cables, 50'		240V, 50 amp		
Condenser	Tecumsek	AE3Y14AA	9A1768096	
(2) Winches	Dayton	4Z327A		
Miscellaneous tools				
Miscellaneous office supplies				
Miscellaneous electrical supplies				
Miscellaneous tubing				
Miscellaneous swaglock fittings				
Miscellaneous hardware				
Space heater				
Miscellaneous padlocks				

Appendix D

Contract: GS-10F-0036K, Task Order: 1104 Lead PR Number: PR-CI-04-10377

Item	Manufacturer	Model #	Serial (ID) #	EPA #
Trailer	Fruehauf	C6HE-Y2	DLR503307	807534
Air Cooler		C810B	12936	
Air Compressor		2800061DUA001	45929NSO42302	
Air Compressor Motor	Dayton	6K827L	C63GKE-4555J977	
Positive Displacement Pump (PDP)	Suterbilt	5-LP	5085736	
PDP Motor	GE MOTORS	5KC184BB211	NPY300	
Dynamometer (Electronic controller, rolls, and flywheels	Clayton	CTE-50	RLC-175	807535
1- carpenter’s level, 4'				
15- trailer jack stands				
Weight calibration set, 45lb.,10 lb. and arbor				
5 pieces of 18" chain				

2 Ramps, aluminum (8'x12')				
Fan	Hartzell			
Fan motor	Reliance	CS	C56E1768M-DZ	
Muffler	Burgess Manning	BEO-3.5	52-170-0	
4 Aluminum ramps (7.5' x 18")	Metro Trailer Manuf.			
Aluminum ramp (2'x12')				
8" OD Tunnel, stainless steel, 10' and 12' sections				
Flexible tube, 3"x14' braided, stainless steel				
4" OD Tunnel, stainless steel sections, total ~ 8'				
Flexible tube (4"x4')				
Filter housing (2'x2' aluminum)				

Tube elbow, stainless steel (8"x24")				
Winch	Dayton	6X190B	X1059057	
Winch post, 6' aluminum				
Water pump		FP6121-00	1E95B	
Floor Jack				
(6) Dilution tunnel support stands				
(2) Jack stands for ramps				
Dilution air heater	Unique Products	507574	8014	
Steel Toolbox, 36"x18"x18"	Payload			
(4) Metal Leg stands				
(26) silicon boots, 11"				
(5) Nylon, rachet style tie-down straps				
Wire cable with hooks, 8'				

Appendix D

Contract: GS-10F-0036K, Task Order: 1104

(5) 2000 lb chain binders				
(1) 5400 lb chain binder				
Nustar Power Pusher		44518		933311
(6) Straps, load binder				

Task Order Line Items

Contract: GS-10F-0036K, Task Order: 1104 Lead PR Number: PR-CI-04-10377

CLIN	SCENARIO A: DESCRIPTION	TOTAL PRICE
BASE	***QUALITY ASSURANCE AND PHASE 1 PILOT STUDIES***	
0001 A	Produce Quality Documentation (SOW Section 5.1)	$64,144.46
0001 B	Pre-Testing Analysis, Non-Response Analysis, Vehicle Pilot Study (Cohort Analysis) (SOW Sections 5.2.1 through 5.2.6, and 5.2.8)	$192,293.00
0001 C	Pilot Testing Task (SOW Section 5.3.1, 5.4.1, 5.4.2)	$286,786.50
0001 D	Contract Incentive Plan	$43,861.63
OPTION 1	***PHASE 2: ROUND 1 VEHICLE TESTING***	
0002 A	Vehicle Recruitment (SOW Section 5.2.7a)	$45,552.89
0002 B	Participation Incentives (SOW Section 5.2.9) ***NOT TO EXCEED***	$105,043.43
0002 C	Vehicle Testing (SOW Section 5.3.3)	$301,982.98
0002 D	Post Round 1 Vehicle Analysis (SOW Section 5.2.10)	$21,975.49
0002 E	Vehicle Emission Analysis (SOW Sections 5.3.2, 5.3.3, 5.4.3, 5.4.4, 5.4.5(Only continuous and integrated PM mass samples), 5.4.7	$583,111.60
0002 F	Speciation Analysis (SOW Section 5.4.5 Only gaseous cmpds, 5.4.5.5)	$255,006.12
0002 G	Data Analysis (SOW Section 5.4.6)	$64,862.43
0002 H	Maintenance of Emission Equipment (SOW Section 5.4.8)	$30,886.10
0002 I	Contract Incentive Plan	$43,861.63
OPTION 2	***PHASE 2: ROUND 1 SPECIATION TOXIC ANALYSIS***	
0003	Speciation Toxic Analysis - all other analyses (SOW Section 5.4.5.2, 5.4.5.3, 5.4.5.4, 5.4.5.6)	$50,923.54
OPTION 3	***PHASE 3: ROUND 2 VEHICLE TESTING***	
0004 A	Vehicle Recruitment (SOW Section 5.2.7b)	$44,077.35
0004 B	Participation Incentives (SOW Section 5.2.9) ***NOT TO EXCEED***	$105,043.43
0004 C	Vehicle Testing (SOW Section 5.3.3)	$289,914.32
0004 D	Vehicle Emission Analysis (SOW Sections 5.3.2, 5.3.3, 5.4.3, 5.4.4, 5.4.5((Only continuous and integrated PM mass samples)), 5.4.7)	$753,625.58
0004 E	Speciation Analysis (SOW Section 5.4.5 Only gaseous cmpds, 5.4.5.5)	$255,006.12
0004 F	Data Analysis (SOW Section 5.4.6)	$37,406.70
0004 G	Maintenance of Emission Equipment (SOW Section 5.4.8)	$28,074.88
0004 H	Contract Incentive Plan	$87,723.26

Task Order Line Items

Contract: GS-10F-0036K, Task Order: 1104 Lead PR Number: PR-CI-04-10377

OPTION 4	***PHASE 3: ROUND 2 SPECIATION TOXIC ANALYSIS***	
0005	Speciation Toxic Analysis - all other analyses (SOW Section 5.4.5.2, 5.4.5.3, 5.4.5.4, 5.4.5.6)	$55,161.01
OPTION 5	***FINAL REPORT / ANALYSIS***	
0006	Final Report / Analysis	$148,139.49

Maximum Total Price $3,894,463.84

TASK ORDER INCENTIVE PLAN

In accomplishment of this task order the U.S. EPA expects the contractor to provide accurate, effective, and timely performance. As such, an incentive shall be established regarding contractor performance. The contractor has the opportunity to be awarded up to 5% of the total task order value as described below:

Deliverable	Incentive	Surveillance Method
PHASE 1 (Line Items 0001A, 0001B, and 0001C) completed in accordance with the attached Performance Work Statement.	For accurate, effective, and timely completion of Phase 1 in accordance with the attached Performance Work Statement, the Contractor may be awarded up to 1.25% of the total value of the established task order price, exclusive of participation incentives.	The contractor will be evaluated based on the accuracy, effectiveness, and timeliness of data received as a result of contractor performance on this task order, as set forth in the Performance Work Statement.
PHASE 2 (Line Items 0002A, 0002C, 0002D, 0002E, 0002F, 0002G, 0002H, and 0003) completed in accordance with the attached Performance Work Statement.	For accurate, effective, and timely completion of Phase 2 in accordance with the attached Performance Work Statement, the Contractor may be awarded up to 1.25% of the total value of the established task order price, exclusive of participation incentives.	The contractor will be evaluated based on the accuracy, effectiveness, and timeliness of data received as a result of contractor performance on this task order, as set forth in the Performance Work Statement.
PHASE 3 (Line Items 0004A, 0004C, 0004D, 0004E, 0004F, 0004G, and 0005) completed in accordance with the attached Performance Work Statement.	For accurate, effective, and timely completion of Phase 3 in accordance with the attached Performance Work Statement, the Contractor may be awarded up to 2.5% of the total value of the established task order price, exclusive of participation incentives.	The contractor will be evaluated based on the accuracy, effectiveness, and timeliness of data received as a result of contractor performance on this task order, as set forth in the Performance Work Statement.