

US EPA ARCHIVE DOCUMENT

TEST/QA PLAN FOR THE VERIFICATION TESTING OF DIESEL EXHAUST CATALYSTS, PARTICULATE FILTERS, AND ENGINE MODIFICATION CONTROL TECHNOLOGIES FOR HIGHWAY AND NONROAD USE DIESEL ENGINES

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1 Introduction

This Environmental Technology Verification (ETV) Test/QA Plan for heavy-duty diesel engine testing at the Department of Emissions Research (DER) of Southwest Research Institute (SwRI) describes how the Federal Test Procedure (FTP), as listed in 40 CFR Part 86 (§86) for highway engines and 40 CFR Part 89 (§89) for nonroad engines, will be specifically implemented for this testing program. Where the FTP is followed exactly, the phrase “without deviation” is used. Where the FTP allows flexibility (e.g., “Alternate methods ... may be used ...”), the specific implementation using this flexibility is described; where the flexibility is not implemented, the phrase “without deviation” is used.

DER certifies that this document and its associated quality documents conform to and contain all the required quality assurance project plan (QAPP) elements that are specified in *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA Publication Number EPA/240/B-01/003, March 2001) and in *Environmental Technology Verification Program Quality and Management Plan for the Pilot Period (1995-2000)* (EPA ETV QMP, EPA Publication Number EPA/600/R-98/064, May 1988).

1.1 Organization of this Plan

This plan is organized to reflect the expectation that SwRI will test several similarly configured technology devices (i.e., diesel exhaust catalysts, particulate filters, and engine modification control technologies) under EPA's ETV program. Sections 1-20 of this document present elements of SwRI's quality system as a testing organization that are common to all tests. Test-specific planning will be documented in a required test-specific addendum, which will be reviewed and approved by EPA before testing.

1.2 Competence of SwRI as an ETV Testing Organization

The following describes the accreditations and registrations of SwRI relevant to this Test/QA Plan (T/QAP).

The DER is registered to International Organization for Standardization (ISO) 9002 “Model for Quality Assurance in Production and Installation.” This independently-assessed quality system provides the basis for quality procedures that are applied to every project conducted in the DER.

DER is accredited to ISO/IEC Guide 25 “General Requirements for the Competency of Calibration and Testing Laboratories” and EN 45001, “General Criteria for the Operation of Test Laboratories.” Under American Association for Laboratory Accreditation (A2LA) Certificate Number 0702-01, DER has been accredited to perform evaluations of automotive fluids, fuels emissions, automotive components, engine and power-train performance and durability using stationary engine dynamometer test stands (light-duty, nonroad, and heavy duty) and vehicle dynamometer facilities, and automotive fleets (see <http://www.a2la2.net/scopepdf/0702-01.pdf>). The certificate accredits DER to use specific standards and procedures, including dynamometer procedures for hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter.

DER has also achieved Ford Tier 1 status for providing engineering services, received the Ford Q1 Quality Award and the Ford Customer-Driven Quality Award, and maintains its status as a Caterpillar-certified Supplier.

1.3 Referenced SwRI Quality Documents

Based upon the ISO registration and the A2LA accreditation achieved, the DER Quality System Manual (QSM), Quality Policy and Procedures (QPPs), and Standard Operating Procedures

(SOPs) will be referenced in this document. These internal quality documents are considered proprietary to SwRI and will be made available for review during the pretest, on-site assessment of the DER technical and quality systems. Any approval of this document is conditional until the referenced quality documents have been reviewed by EPA and Air Pollution Control Technology Verification Center (APCTVC) assessors and have been determined to conform to the specific required elements of an EPA QAPP. In the following sections of this document, specific SwRI quality documents that describe DER's conformance with specific QAPP required elements will be referenced. The specific required elements will be also referenced in these sections.

1.4 Purpose

The purpose of this Test/QA Plan is to describe testing that satisfies the specifications of the *Generic Verification Protocol (GVP) for Diesel Exhaust Catalysts, Particulate Filters, and Engine Modification Control Technologies for Highway and Nonroad Use Diesel Engines* developed under the authority of the APCTVC at RTI. Specifically, it is written to conform to all specifications of *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* and the EPA ETV QMP. Specifically, this document describes the quality system of SwRI and the procedures applicable to meeting EPA quality requirements that are common to all ETV tests. Test-specific addenda, noted below, will be reviewed and approved by EPA prior to testing.

2 Test Description and Test Objectives

This testing, based on the FTP, is to quantify the effectiveness of commercial ready emissions control technologies for oxides of nitrogen (NO_x), hydrocarbons (HCs), particulate matter (PM), and carbon monoxide (CO) that are intended for use on diesel engines considered mobile sources of air pollution. For a specific technology, the number and type of FTP tests may differ [see *GVP, Section 5.1*] from certification requirements in order to satisfy the data quality objectives [see *GVP, Section 2.3*].

A description of a specific technology and engine to be tested will be documented as a test-specific addendum to this document that will be submitted for EPA review and approval prior to the start of testing. The test-specific addendum will conform to required elements A5 (Problem Definition/Background) and A6 (Project/Task Description) of EPA QA/R-5.

3 Critical Measurements, Data Quality Objectives, Data Quality Indicator Goals, Schedule and Milestones

3.1 Critical Measurements

Critical measurements are for the exhaust gas concentrations of NO_x, HC, PM and CO [see *GVP, Section 2.3*].

3.2 Data Quality Objectives (DQOs)

The data quality objectives of this testing [see *GVP, Section 2.3*] focus on the measurements of NO_x, HC, PM, and CO. Test requirements are those found in §86 and §89 FTP test methods, with the number of tests being determined by:

1. A minimum of 3 tests,
2. Additional tests indicated [see *GVP, Section 5*], and
3. Additional tests desired by the applicant.

The rationale for the number of FTP test cycles will be included in the test-specific addenda to this document, which will conform to required element B1 of EPA QA/R-5.

3.3 Data Quality Indicator Goals (DQIGs)

The DQIGs for individual measurements will conform to those specified in relevant sections of the FTP, as shown in Table 1.

Table 1 Data Quality Indicator Goals (DQIGs)

| Param | SOP | CFR | Acceptance Criteria |
|----------|----------------|------------------|---|
| NOx | 06-002 | 86.1323-84(a)(4) | NO ₂ content ≤ 5% of NO concentration |
| NOx | 06-002 | 86.1323-84(a)(7) | Converter efficiency ≥ 90% (SwRI: 95%) |
| | 06-003 | | Gas Divider linearity: known - observed ≤ 2.0% |
| | 06-003 | | Gas Divider linearity, Full-Scale: known - observed ≤ 0.5% |
| NOx | 06-025 | | Analyzer initial zero = 0.0 ± 0.5 meter division |
| NOx | 06-025 | | Analyzer initial span: known - observed ≤ 0.5 meter division |
| NOx | 06-025 | | Analyzer Post-check zero & span: drift ≤ 1.0 meter division |
| NOx | 06-041 | | CO ₂ quench, pre-test zero: 0.0 ± 0.5% full scale |
| NOx | 06-041 | | CO ₂ quench, pre-test span: known - observed ≤ 0.5% full scale meter |
| NOx | 06-041 | | CO ₂ quench, post-test zero & span: drift ≤ 2% full scale meter |
| NOx | 06-041 | | CO ₂ quench: ≤ 3% full scale meter |
| Sampling | 07-003 | | 20°C ≤ CVS (constant volume sampler) dilution air temp ≤ 30°C |
| Sampling | 07-009, 07-038 | | Background of CVS & Tunnel: ≤ 10 ppmC (carbon) |
| Sampling | 07-009, 07-038 | | Background: CVS tunnel - bag ≤ 2 ppmC |
| Sampling | 07-009 | | NOx post-test zero & span drift ≤ 2% full scale meter |
| Sampling | 07-009 | | HC post-test zero & span drift ≤ 3% full scale meter |
| Weighing | 07-020 | | Chamber: 19 °C < Temperature < 25°C |
| Weighing | 07-020 | | Chamber: 37% < relative humidity < 53% |
| Weighing | 07-020 | | Reference Filter weight change ≤ 20 micrograms |
| Weighing | 07-020 | | Reference Mass weight change ≤ 10 micrograms |
| Bag Cart | 07-023, 07-038 | | Pre-test zero: 0.0 ± 0.5% full scale meter |
| Bag Cart | 07-023, 07-038 | | Pre-test span: known - observed ≤ 0.5% full scale meter |
| Bag Cart | 07-023, 07-038 | | Pre-test zero & span check: known - observed ≤ 1% full scale meter |
| Bag Cart | 07-023 | | Post-test zero & span: drift ≤ 2%fs |
| Testing | 07-028 | | Gas Meter #2 (secondary flow) counts ≥ 373 counts/min |

Test-specific DQIGs will be documented in the test-specific addenda to this document.

3.4 Schedule and Milestones

Following submittal of the T/QAP, an independent quality system and technical system assessment will be performed.

A typical test-specific schedule is shown in Figure 5 and is based on experience. It depicts the best estimate of elapsed time required for each listed task, beginning on January 1, 2002. Corresponding changes can be inferred for different start times.

3.5 Test Specifications for Non-critical Measurements

Critical measurements focus on exhaust gas concentrations of NOx, HC, PM, and CO. The associated test specifications comply with other specifications of the FTP as noted below.

4 Test Organization and Responsibilities

The project organization is depicted in Figure 1, including testing team responsibilities at Southwest Research Institute.

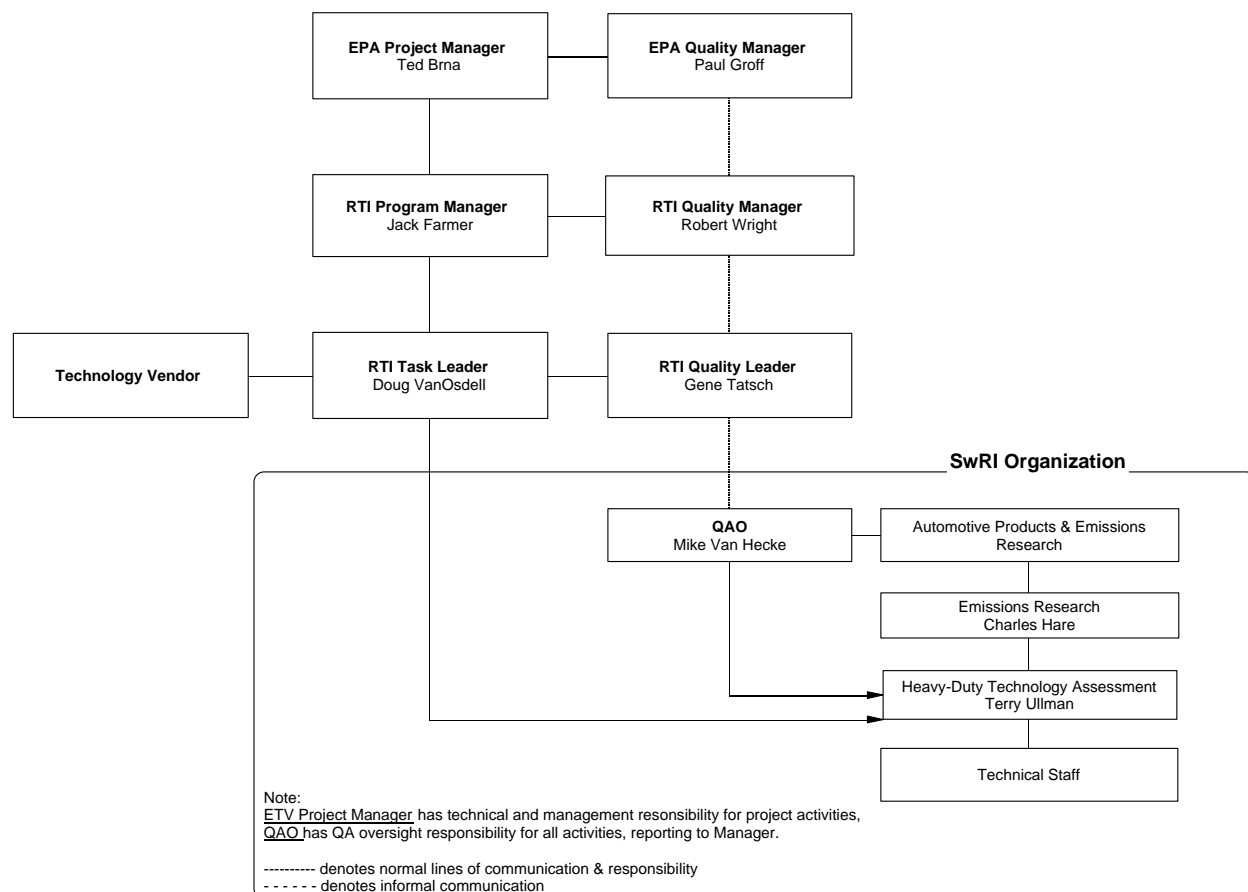


Figure 1 - Testing Organization

The US Environmental Protection Agency (EPA) has overall responsibility for the Environmental Technology Verification (ETV) Program for APCTVC. Research Triangle Institute (RTI) is EPA's verification partner in this effort. Southwest Research Institute (SwRI) is the technology-specific testing organization for mobile sources within the APCTVC.

Management and testing are performed in accordance with procedures and protocols defined by a series of quality management documents. These include (see Section 20), in order of precedence:

- EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5
- EPA's Quality and Management Plan for the overall ETV program (EPA QMP),
- QMP for the overall APCTVC (APTC QMP),
- SwRI's Quality System Manual -2000, and DER's Quality System Manual (QSM)
- the Generic Verification Protocol (GVP) for Verification Testing of Diesel Exhaust Catalysts, Particulate Filters, and Engine Modification Control Technologies for Highway and Nonroad Use Diesel Engines, and
- this Test/QA Plan.

Southwest Research Institute will, for RTI, conduct field verification of applicable technology, analyze data, and prepare a verification report and verification statement. The various management and quality assurance (QA) responsibilities are divided between EPA, RTI, and SwRI key project personnel as defined below. The lines of authority between key personnel for this project are shown on the project organization chart in Figure 1

4.1 Organizational Responsibilities

Project management responsibilities are divided among the EPA, RTI, and SwRI staff as described below.

4.1.1 EPA

4.1.1.1 Project Management

The EPA Project Manager, Ted Brna, has overall EPA responsibility for the APCTVC. He is responsible for obtaining EPA's final approval of project Test/QA plans and reports.

4.1.1.2 Quality Manager

The EPA Quality Manager for the APCTVC is Paul W. Groff of EPA's Air Pollution Prevention and Control Division. His responsibilities include:

- Communicate quality systems requirements, quality procedures, and quality issues to the EPA Project Manager and the RTI Project Manager;
- Review and approve APCTVC quality systems documents to verify conformance with the quality provisions of the ETV quality systems documents;
- Perform technical systems audits (TSAs) and performance evaluations (PEs) of verification tests, as appropriate; and
- Provide assistance to APCTVC personnel in resolving QA issues

The EPA Quality Manager (or his designee) will perform the following specific activities associated with the verification tests:

- Review and approve the GVP for this technology;
- Review and approve
 - this SwRI-specific test/QA plan,
 - each verification report, and
 - each verification statementfor each technology tested under this test/QA plan; and
- Perform a PE of the verification test of SwRI's ETV testing operations.

4.1.2 RTI

4.1.2.1 Project Manager

The RTI Program Manager for the APCTVC is Jack Farmer, director of RTI's Engineering & Technology Division. He has overall responsibility for QA in the APCTVC and in technology-specific verification tests. He will assign technology verification task leaders; oversee verifications; review technical panel makeup; and review generic verification protocol and test-specific quality documents. These responsibilities are described in greater detail in Section 2 of the APCT's QMP.

The Deputy Manager, Douglas VanOsdell, reports to the APCTVC Program Manager and substitutes for the APCTVC Program Manager if he is absent. The Deputy Manager is responsible for any functions delegated to him by the APCTVC Program Manager. For these technologies, he will prepare the draft GVP and provide overall management of the verification test.

4.1.2.2 Quality Manager

The RTI Quality Manager for the APCTVC is Robert Wright of RTI's Center for Environmental Measurements, which is organizationally independent of the RTI Program Manager. He is responsible for ensuring that all verification tests are performed in compliance with the QA requirements of the APCTV CQMP, GVPs, and test/QA plans. He has resources available to

ensure conformance with the requirements and ensures that all personnel understand the requirements. Following are his general responsibilities:

- Prepare the APCTVC QMP and assist the RTI Program Manager in the annual review and revision of this document, as needed;
- Communicate with quality leaders for specific verification tests;
- Review and approve the GVPs, test/QA plans, and any needed SOPs that will be developed by technology verification test leaders and test-specific quality managers; oversee test-specific quality training;
- Conduct test-specific TSAs and PEs in cooperation with the EPA Quality Manager and test-specific quality managers;
- Review and approve the test results and the quality control (QC) results from verification tests; and
- Prepare the QA section of each verification test report and verification statement.

4.1.3 SwRI

4.1.3.1 Program Management

Terry Ullman has overall responsibility for technical and administrative activities, and exercises technical leadership to promote quality in project performance. He will also function as liaison for clients in specific technical areas and supervise the activities of project leaders. He is responsible for preparing test-specific addenda to this T/QAP.

4.1.3.2 Quality Assurance

Mike Van Hecke plays a central role in the introduction, implementation, and consistent application of continuous quality improvement at the DER. He fulfills the role as quality management representative for the department and conducts audits of all pertinent quality standards to ensure compliance. He is administratively independent of the unit generating the data. He is responsible for maintaining the official, approved version of this document, for reviewing and approving test-specific addenda to this document, and for the audit of data quality (ADQ) (per Section 13.3), and reconciling test results with DQOs via DQIG attainment (per Section 17).

4.1.3.3 Support Personnel

All persons supporting the project will be qualified as prescribed by QPP 10 (Training and Motivation).

5 Documentation and records

Test-specific documentation and records will be processed as specified in SwRI QPP 03 (Document Preparation and Control), QPP 14 (Quality Records), QPP 07 (Testing and Sample Analysis). See Section 12 for details of test data acquisition and management.

In accordance with Part A, Sections 5.1 and 5.3 of EPA's QMP, SwRI will retain all test-specific documentation and records for 7 years after the final payment of the agreement between SwRI and the APCTVC. RTI will retain all verification reports and statements for 7 years after final payment of the agreement between RTI and EPA.

6 Test Design

The test design follows the FTP, with the number of separate FTP tests for a specific technology determined by the specified algorithm [*GVP, Section 5.1*].

The rationale for the number of FTP test cycles will be included in the test-specific addenda to

this document, which will conform to required element B1 of EPA QA/R-5.

7 Sampling procedures

The sampling system is comprised primarily of the exhaust sampling system to which continuous measurement devices and particulate filters are attached.

7.1 Exhaust Gas Sampling System

The exhaust gas sampling system conforms to §86.1310, and §89.308. The system that will be used at SwRI is depicted in Figure 2.

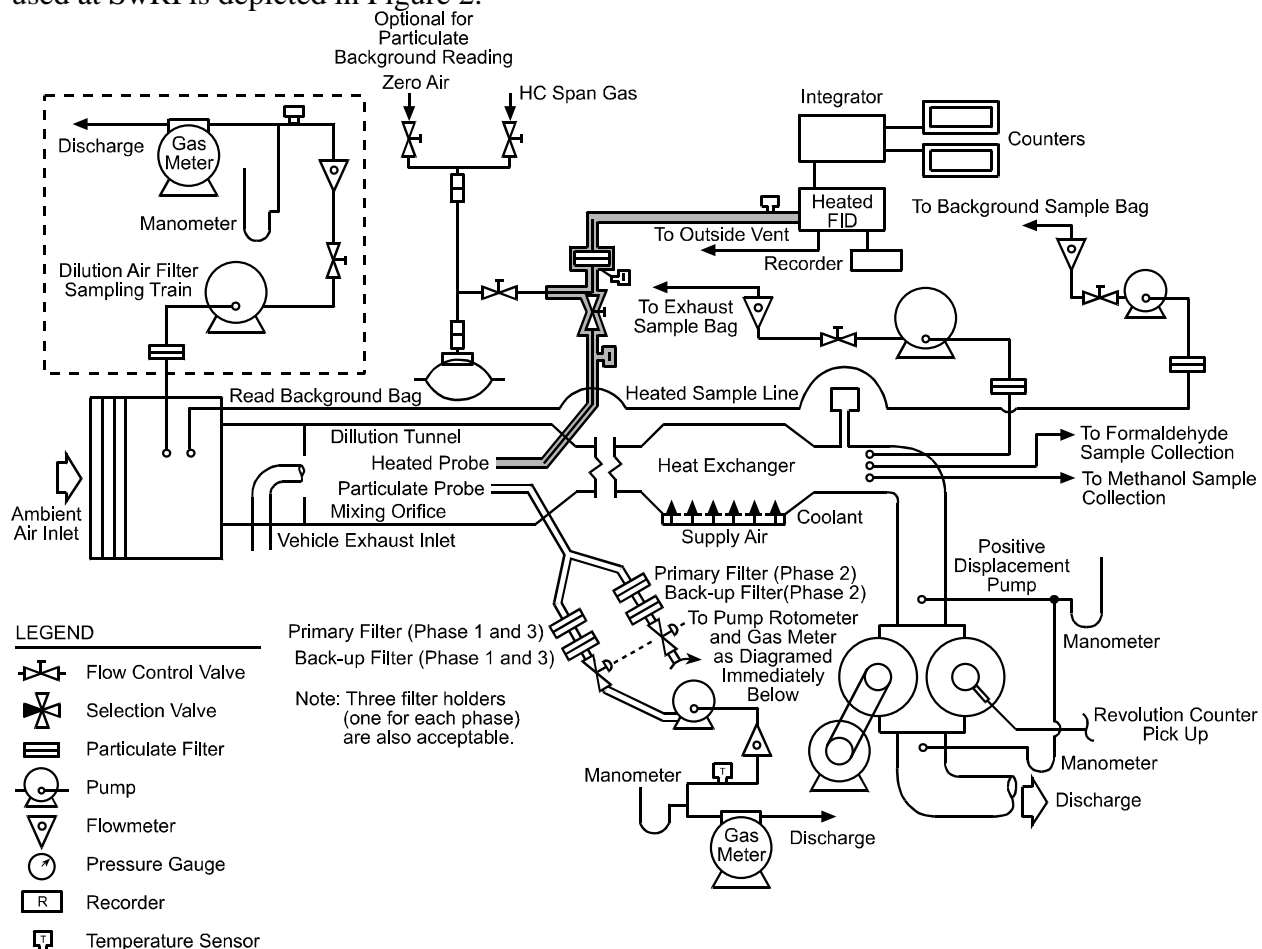


Figure 2 - Gaseous and Particulate Emissions Sampling System System (PDP-CVS)

7.2 Exhaust Gas Measurement System

The exhaust gas measurement system conforms to §86.1310, and §89.309. The configuration that is used at Southwest Research Institute is shown in Figure 3.

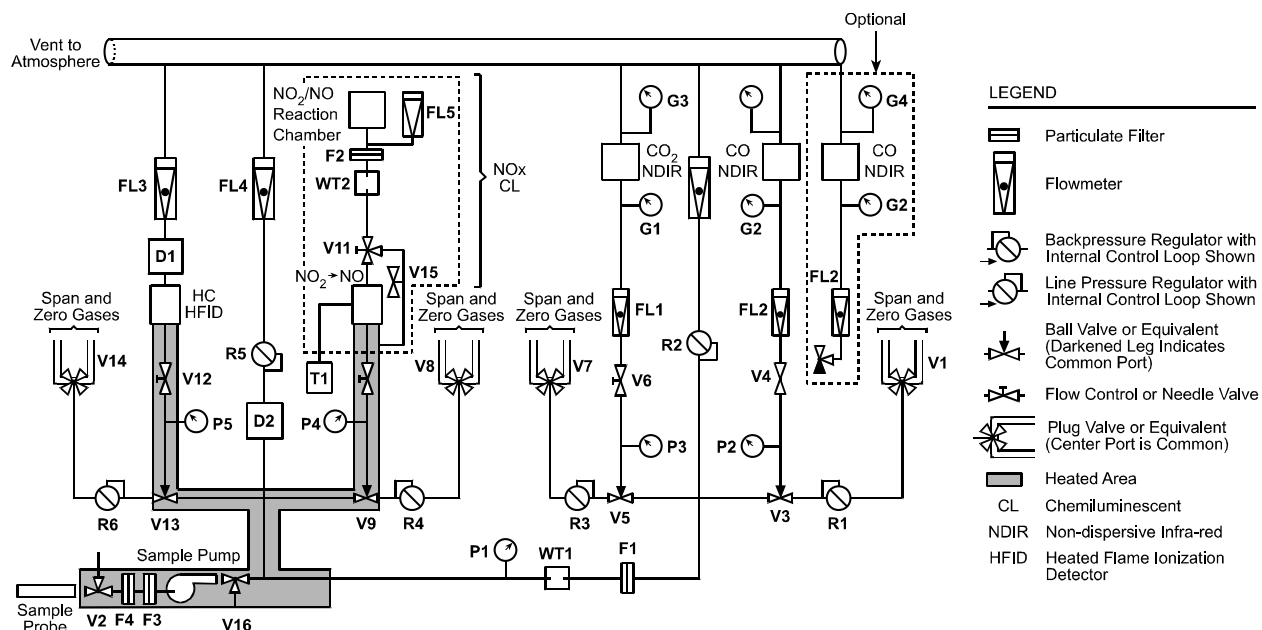


Figure 3 - Exhaust Gas Sampling and Analytical Train

The specific instruments to be used in this test will be selected from those listed in the master list of calibration equipment maintained in the SwRI DER "Recall Database." This system is controlled by the Supervisor of Instrumentation.

7.3 Filter Weighing

Particulate filters are stored, conditioned, and weighed in Room LD-3 which conforms to §86.1312. The balances that will be used are listed in the "Recall Database."

8 Sample Handling and Custody

Only particulate matter (PM) filter measurements and bag samples involve manual handling, since gaseous emission measurements are made and recorded by the computer-controlled data system (Figure 4) associated with the continuous sampling system (Figure 2 and Figure 3).

8.1 Particulate Filters

The PM filters are prepared and processed according to SwRI SOP# 07-020 which specifies a method of conditioning and weighing filters used to collect particulate samples during exhaust emission testing. This SwRI SOP conforms to required element B3 (Sample Handling and Custody) of EPA QA/R-5.

8.2 Bag Samples

Samples are handled according to SwRI SOP 07-023. This SOP conforms to required element B3 (Sample Handling and Custody) of EPA QA/R-5.

9 Analytical procedures

9.1 Filter Weighing

The chamber in which the particulate filters are conditioned and weighed conforms to §86.112 without deviation.

9.2 Gaseous Analyzers

Gaseous analyzers depicted in Figure 3 conform to §86.309, §86.1311, and §89, Subpt D, App B, Figure 1 without deviation. Their operation is specified in SwRI SOP# 07-009, which conforms

to required elements B4 (Analytical Methods), B5 (Quality Control), and B6 (Instrument/Equipment Testing, Inspection, and Maintenance) of EPA QA/R-5.

10 Test-specific procedures for assessing data quality indicators

Activities are specified in QPP 09 for assessing the quality of data from each test event. These SOPs conform to required elements B5 (Quality Control) and D3 (Reconciliation with User Requirements) of EPA QA/R-5.

11 Instrument calibration and frequency.

Reference: QPP 05 Measurement and Test Equipment, which conforms to required element B7 (Instrument/Equipment Calibration and Frequency) of EPA QA/R-5.

11.1 Gas Meter Calibrations

As specified in SwRI SOP# 06-003, all gas meters, selected from the list of routinely used instruments given in the DER Recall Database, are calibrated to conform to §86.119 and §89.319. Any necessary correction is made by mechanically adjusting the meter and recalibrating.

11.2 Gaseous Analyzers

11.2.1 Hydrocarbon Analyzers

The hydrocarbon analyzers used in this testing program, listed in the DER "Recall Database", are calibrated in conformance with §86.1321 and §89.319, using the procedures specified by the applicable flame ionization detector(FID/heated flame ionization detector (HFID) manufacturer. Their operation is specified by SwRI SOPs #06-012, #06-021, #06-024, and #06-044, which conform to required element B7 (Instrument/Equipment Calibration and Frequency) of EPA QA/R-5.

11.2.2 Carbon Monoxide Analyzers

The carbon monoxide analyzers used in this testing program, listed in Attachment 1, are calibrated in conformance with §86.1322 and §89.320, using zero-grade air. Their operation is specified by SwRI SOPs #06-016 and #06-023, which conform to required element B7 (Instrument/Equipment Calibration and Frequency) of EPA QA/R-5.

11.2.3 Oxides of Nitrogen Analyzers

The oxides of nitrogen analyzers used in this testing program, listed in the DER "Recall Database," are calibrated in conformance with §86.1323 and §89.321, using zero-grade air. Their operation is specified by SwRI SOPs #06-002, #06-012, #06-025, and #06-041, which conform to required element B7 (Instrument/Equipment Calibration and Frequency) of EPA QA/R-5..

11.2.4 Carbon Dioxide Analyzers

The carbon dioxide analyzers used in this testing program, listed in the DER "Recall Database," are calibrated in conformance with §86.1324 and §89.322, using zero-grade air. However, these measurements are not critical measurement for this testing program. Their operation is specified by SwRI SOP #06-023, which conforms to required element B7 (Instrument/Equipment Calibration and Frequency) of EPA QA/R-5.

11.2.5 Methane Analyzers

The methane analyzers used in this testing program, listed in the DER "Recall Database," are calibrated in conformance with §86.1325, without deviation. However, these measurements are not critical measurement for this testing program.

11.3 Analyzer Gases

The gases used for instrument calibration conform to §86.114 and §89.312 without deviation.

12 Data Acquisition and Management

Data acquisition and data management are performed according to QPP #08 Data Processing and Reduction, which conforms to required element B10 (Data Management) of EPA QA/R-5.

The planned data streams, with responsibilities of the test manager and QAO, are depicted in Figure 4. The test manager is operationally responsible for all aspects of a test. The QAO is operationally responsible for all data quality aspects of a test, with primary, but not exclusive, focus on the areas indicated in the figure.

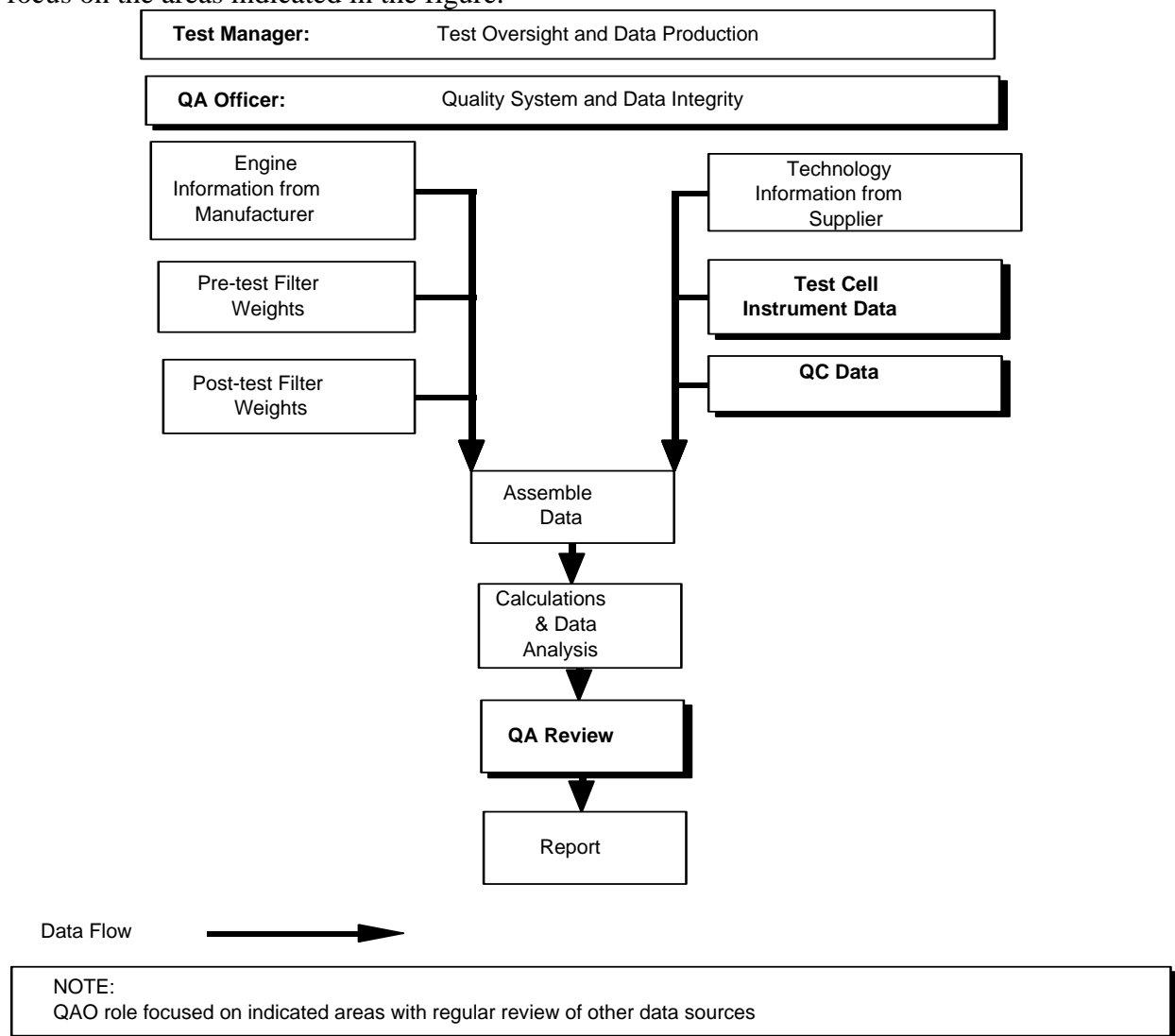


Figure 4 - ETV Data Management System

Qualitative data regarding the technology to be tested, per §86.1344, and §89.405, are manually recorded on the data sheets specified in SwRI #SOP 07-003. Operating and emissions data are captured by the data system, described schematically in Figure 4.

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13 Internal and External Audits

13.1 Quality System and Technical Systems Audits

Internal audits by SwRI are conducted as specified in QPP #12 (Internal Audits) and SwRI SOP #12-001 (Quality Audits), which conform to required element C1 (Assessments and Response Actions) and C2 (Reports to Management) of EPA QA/R-5.

13.2 Performance Audits

Performance audits are performed according to QPP 12 (Internal Audits), which conforms to required element C1 (Assessments and Response Actions) and C2 (Reports to Management) of EPA QA/R-5.

13.3 Audit of Data Quality

In accordance with Table 9.1 of the ETV QMP, the QAO will conduct an audit of data quality (ADQ) of at least 10 percent of all of the verification data. The ADQ will be conducted in accordance with EPA's *Guidance on Technical Audits and Related Assessments for Environmental Data Operations*. EPA QA/G-7 (EPA Publication Number [EPA/600/R-99/080](#), January 2000), including a written report detailing the results of custody tracing, a study of data transfer and intermediate calculations, a review of QA and QC data, a study of project incidents that resulted in lost data, and a review of study statistics. The ADQ report ends with conclusions about the quality of the data from the project and their fitness for their intended use.

13.4 External Assessments

SwRI will cooperate with any external assessments by EPA or APCTVC. RTI and/or EPA assessors will conduct a single mandatory quality and technical systems assessment of DER before the start of the first test at DER. They may conduct optional witness assessments during the first test or any subsequent test. The external assessments will be conducted as described in EPA QA/G-7.

14 Corrective Action

Corrective action is performed according to QPP 11 Nonconformance and Corrective Action, which conforms to required elements B5 (Quality Control) and C1 (Assessments and Response Actions) of EPA QA/R-5.

15 Assessment Reports to EPA

Internal assessment reports will be reviewed by the SwRI QAO who will respond as noted in Section 14. The written report of the ADQ will be submitted to the APCTVC for review.

16 Data Reduction, Review, Validation and Reporting.

Reference: QPP 08 Data Processing and Reduction, QPP 09 Analysis and Reporting, which conforms to required elements D1 (Data Review, Verification, and Validation) and D2 (Verification and Validation Methods) of EPA QA/R-5.

17 Reporting of data quality indicators for critical measurements.

Reference: QPP 08 Data Processing and Reduction, QPP 09 Analysis and Reporting, which conforms to required element D3 (Reconciliation with user requirements) of EPA QA/R-5.

18 Limitations of the Data

Reference: QPP 08 Data Processing and Reduction, QPP 09 Analysis and Reporting, which conforms to required element D3 (Reconciliation with User Requirements) of EPA QA/R-5.

19 Deviations from GVP

No deviations from the GVP or this document are anticipated. If any deviations are identified in the course of planning and implementing a technology-specific test, the SwRI staff will consult with APCTVC staff as soon as possible to resolve the issues. As per Section 2.7 of EPA/QA R-5, EPA will be notified of any significant deviations and the QAO will revise this document and submit it to EPA for review and approval.

20 Referenced Quality Documents

20.1 EPA-ETV

| | |
|----------------|--|
| EPA QA/R-5 | <i>EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, EPA Publication Number EPA/240/B-01/003, March 2001.</i> |
| EPA ETV QMP | <i>Environmental Technology Verification Program Quality and Management Plan for the Pilot Period (1995-2000), National Risk Management Research Laboratory, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, EPA Publication Number EPA/600/R-98/064, May 1998 (or current version)</i> |
| EPA QA/G-5 | <i>Guidance on Quality Assurance Project Plans, EPA QA/G-5, Office of Environmental Information, U.S. Environmental Protection Agency, EPA Publication Number EPA/600/R-98/018, February 1998</i> |
| EPA QA/G-7 | <i>Guidance on Technical Audits and Related Assessments, EPA QA/G-7, Office of Environmental Information, U.S. Environmental Protection Agency, EPA Publication Number EPA/600/R-99/080, January 2000</i> |

20.2 APCTV

| | |
|---------------|---|
| APCTVC QMP | Verification Testing of Air Pollution Control Technology, Quality Management Plan, October 1998. |
| GVP | Generic Verification Protocol for Diesel Exhaust Catalysts, Particulate Filters, and Engine Modification Control Technologies for Highway and Nonroad Use Diesel Engines, January 2002. |

20.3 Southwest Research Institute

20.3.1 Quality Policy and Procedures (QPPs)

| | |
|------------|--|
| QSM | QUALITY SYSTEM MANUAL – 2000, April 2001 |
| QPP-03 | Document Preparation and Control |
| QPP-05 | Measurement and Test Equipment |
| QPP-07 | Testing and Sample Analysis |
| QPP-07-003 | Transient Test for Heavy-Duty Diesel Engines |
| QPP-08 | Data Processing and Reduction |
| QPP-09 | Analysis and Reporting |
| QPP-10 | Training and Motivation |
| QPP-11 | Nonconformance and Corrective Actions |

- QPP-12 Internal Audits
- QPP-14 Quality Records

20.3.2 Standard Operating Procedures (SOPs)

- SOP-06-003 Linearity Verification of Gas Dividers
- SOP-06-002 NO_x Converter Efficiency Determination
- SOP-06-012 Monthly Calibration of Analyzers for Continuous Dilute Gaseous Exhaust
- SOP-06-016 Wet CO₂ Interference Check for CO Analyzers
- SOP-06-021 FID Response for Methane
- SOP-06-025 NO_x Analyzer and System Response Checks
- SOP-06-041 NO_x Analyzer CO₂ Quench Check
- SOP-06-044 Hydrocarbon Analyzer Optimization
- SOP-07-009 Emissions Testing During Heavy-Duty Diesel Engine Transient Cycle
- SOP-07-020 Particulate Filter Conditioning and Weighing
- SOP-07-023 Operation of Bag Cart
- SOP-12-001 Quality Audits

Figure 5 - Typical Test-Specific Tasks and Schedule

