National Environment Protection Council
Proposed Diesel Emissions
National Environment Protection Measure
PREPARATORY WORK

IN-SERVICE EMISSIONS PERFORMANCE
PROJECT 4
IN-SERVICE CERTIFICATION CORRELATION STUDIES

1. OBJECTIVES

1.1 To measure the emission performance of a sample of diesel powered vehicles when tested on benchmark tests based on the requirements of Australian Design Rules 70/00 and 30/00.

1.2 To establish correlations between the results of the benchmark tests and the emissions of the same vehicles when tested on a Complex Urban Emission Drive Cycle (CUEDC), and on two specified in-service emission test(s).

2. BACKGROUND

As preparation for a diesel National Environment Protection Measure (NEPM) previous projects have been established to:

- determine typical driving cycles and real world emission performance for diesel engine vehicles in Australia under a variety of road conditions;
- develop a computer model to enable the contribution of diesel engine vehicles to emissions to be calculated and the effect of changes in emission standards etc. to be predicted; and
- establish a short list of possible short tests for diesel vehicles and identify a suitable test for use in in-service emissions testing.

It is now proposed to develop the linkages between in-service and inventory diesel vehicle emission tests and benchmark tests based on the requirements of Australian Design Rules 70/00 and 30/00.

ADR 70/00 emission certification of light duty diesel vehicles (≤3.5 tonnes) is conducted on a chassis dynamometer. Heavy duty vehicles (≥3.5 tonnes) are certified on an engine dynamometer (ie engine removed from vehicle).

ADR 30/00 certification only requires the measurement of smoke emissions. Testing can be conducted on a chassis dynamometer or an engine dynamometer.

All in-service emission testing is done using a chassis dynamometer, or from stationary vehicle tests or on-road observations of vehicles.

There is a need to establish a correlation between the emissions performance on certification and in-service tests in order to ensure that any in-service pass/fail criteria (based on the short in-service test) is not likely to be more stringent than those specified in the original standard, and to assist in setting a benchmark for vehicles that receive good in-service maintenance and servicing.

ADR 70/00 allows for certification to several alternative (UN ECE, Japanese and US) standards. The UN ECE and Japanese standards are steady state modal tests and the US standard specifies a transient test cycle.

To provide a consistent basis for the comparison of vehicles certified to a range of certification standards it has been decided to test all vehicles to the same benchmark tests. These tests will be based on the UN ECE tests used for certification to ADR70/00 and ADR30/00. The tests are specified in UN ECE Regulation 49/02 for heavy vehicles, UN ECE Regulation 83/02 for light vehicles and UN ECE Regulation 24/03 for smoke emissions.

To perform this work, the consultant must have an in-depth knowledge of diesel vehicle exhaust emission testing, heavy-duty vehicle chassis dynamometers, diesel gaseous analysers and particulate measuring equipment suitable for transient drive cycle analysis. It is anticipated that prospective tenderers may need to form partnerships in order to achieve the necessary combination of skills required to meet the testing, analytical and equipment requirements of this project.

3. SCOPE

3.1 Testing

3.1.1 Heavy Vehicles

Testing is to be carried out on a sample of 12 vehicles. 4 of the vehicles are to be pre-ADR70/00, 1990-95 models, the remaining 8 vehicles are to be 1996-99 models certified to one of the standards in ADR70/00.

Vehicles to be tested will include a representative sample from the heavy vehicle ADR categories ME, NB and NC, as approved by the Project Manager.

All vehicles will be tested on:

- the UN ECE Reg 49/02 certification test;
- a chassis dynamometer to, as far as is possible, replicate the certification drive cycle of UN ECE Reg 49/02;
- the UN ECE Reg 24/03 certification test (on an engine dynamometer);
- the UN ECE Reg 24/03 certification test, performed on a chassis dynamometer;
- the relevant CUEDC; and
- two of the in-service assessment procedures from the list in Appendix 3. The specific tests will be identified during Project 2.2 Vehicle Testing.

Note: The R49/02 benchmark test will require that engines be removed from vehicles for testing.

3.1.2 Light Vehicles

Testing is to be carried out on a sample of 20 vehicles. 6 of the vehicles are to be pre-ADR70/00 1990-95 models, the remaining 14 vehicles are to be 1996-99 models certified to one of the standards in ADR70/00.

Vehicles to be tested will include a representative sample from the light vehicle ADR categories MA, MB, MC, MD and NA as approved by the Project Manager.

All vehicles will be tested on:

- the UN ECE Reg 83/02 certification test;
- the UN ECE Reg 24/03 certification test;
- the relevant CUEDC; and
- two of the in-service assessment procedures from the list in Appendix 3. The specific tests will be identified during Project 2.2 Vehicle Testing.

3.2 Equipment Requirements

Chassis Dynamometer

A chassis dynamometer is required for the ADR70/00 and ADR30/00 benchmark tests for light duty vehicles, and for the CUEDCs and dynamometer based short tests for all vehicles.

The dynamometer must be capable of meeting the requirements of UNECE Regulation 83 specified in ADR 70/00.

The CUEDCs are transient in nature and will require the use of a dynamometer with either inertia rolls, or computer-controlled dynamic load inertia simulation. The chassis dynamometer system(s) proposed will have to be capable of testing a range of small passenger vehicles up to large buses and articulated trucks. Detailed guidelines are set out in Appendix 2, section 4.

Engine Dynamometer

An engine dynamometer is required for the ADR70/00 and ADR30/00 benchmark tests for heavy duty vehicles. The dynamometer must be capable of meeting the requirements of UN ECE Regulation 49 specified in ADR 70/00.

Exhaust Gas Sampling and Analysis

Exhaust gas sampling and analysis requirements must meet the requirements of the UN ECE Regulations specified in ADR70/00. Indicative guidelines are contained in Appendix 2, section 5.

Particulate Sampling

Sampling of particulates will need to be conducted using a full flow dilution tunnel, in accordance with the requirements of the UNECE Regulations specified in ADR70/00.

Smoke Measurement

Smoke opacity measurement shall be in accordance with the methods and with the equipment as specified in UNECE Regulation 24/03.

In-Service Maintenance

Equipment requirements for the in-service emission short tests are set out in the test descriptions in Appendix 3.

3.3 Analysis of Results

The successful tenderer shall:

- Provide the required emissions data from all tests;
- Establish and report the test correlation between
  - (a) short test and benchmark test for NOx, THC, particulates and smoke;
  - (b) benchmark test and CUEDC for NOx, THC, particulates and smoke; and
  - (c) for heavy vehicles only, benchmark test and benchmark test on a chassis dynamometer for NOx, THC, particulates and smoke.

  The correlations in (a) to (c) will be determined for each nominated ADR vehicle category, traffic flow condition, and the overall CUEDC cycles.

  Tenders should indicate how measurements from candidate in-service maintenance tests that are measured in concentration units (eg. ppm) will be correlated with measurements measured in grams per kilometre for the CUEDCs and ADRs.
- Evaluate and report on the sensitivity of the short tests to reflect changes in emission performance by vehicles tested on the CUEDCs and benchmark test.

4. OUTPUT

The successful tenderer is required to provide the following:

4.1 An interim report discussing the results of 10 light duty vehicles and 4 heavy duty vehicle tests.

4.2 Draft Final Report

4.3 Final Report within 2 weeks of receiving comments from the Project Manager on the draft Final Report.

5. MILESTONES

It is anticipated that the project will commence on a date agreed prior to the signing of the contract. Milestone achievement of Outputs 4.1, 4.2 will be reported as follows:

- 1st detailed Report including preliminary data and analysis within 4 weeks of project commencement;
- draft Final Report within 8 weeks of project commencement; and

- Final Report within 2 weeks of receiving comments from the Project Manager on the draft Final Report.

6. REPORTING

6.1 Progress reports

The successful tenderer will provide progress reports lodged fortnightly with the Project Manager in writing (typed) by letter, fax or e-mail. The initial progress report is to be presented to the Project Manager one calendar fortnight from project commencement.

Each progress report must include a clear statement of whether or not the project is running on time and a brief summary of progress since the previous progress report.

The contractor may be required to report to meetings of the Project Team.

6.2 Project report

The Final Project Report must meet the Project Manager's requirements in terms of style and format. All reports must be supplied to the NEPC Service Corporation in a printed form and in an electronic format fully compatible with Microsoft Word 97 and Microsoft Excel 97, and in a comprehensive format suitable for electronic publishing. All raw and derived data, associated formulae, and analyses shall be provided in an electronic form which readily enables further analysis by a third party.

6.3 Data

All data gathered under this project will be provided to the project manager in a format compatible with MS Excel 97, MS Access, or as agreed to in writing.

7. PROJECT MANAGEMENT

The NEPC Service Corporation Project Manager is Mr Marc Thompson.

Project proposals must specify a person from the tenderer's organisation who will be responsible for the project. The nominated person will be required to report to the Project Manager and/or the Project Technical Committee on the progress of the project in accordance with section 6.1 and on any difficulties envisaged which might affect the project outcome or timetable. The successful tenderer will notify the Project Manager of any proposed alteration to the personnel assigned to the completion of this project, prior to any such alteration.

8. SUBMISSION OF TENDERS

8.1 Tender Requirements

Tenders must be submitted in writing as specified in section 11 and must include at least the following:

- a demonstrated understanding of the Project Brief and an appreciation of the scope of the task;
- the name and position within the organisation of the person nominated to be responsible for the project and percentage of their working time to be devoted to the project;
- state the details of the qualifications and experience, including recent relevant projects, of all persons who would work on the project, the percentage of their working time committed to the completion of this project and an indication of the role they would undertake, including details of any sub-contracting arrangements;
- a proposed methodology for the project, in sufficient detail to establish that the tenderer understands the issues and requirements of the project, thus ensuring successful outcomes;
- the total cost of the project, including outline estimates of costs other than fees;
- the proposed dates for beginning and completing the project and a suggested schedule of output delivery and milestones, including identification of any constraints perceived by the tenderer;
- a proposal for progress payments through the course of the project;
- details of quality assurance and best practice principles applied by the tenderer; and
- any other information the tenderer considers would facilitate evaluation of the tender or establish their suitability to undertake the project.

8.2 Criteria for Selection

The selection of the successful contractor will be based on the following:

- value for money of the proposed method;
- demonstrated understanding of the project requirements;
- ability to complete the project within the identified time frame using the methodology proposed;
- ability to interpret the results in a scientifically rigorous manner and to present the findings by oral presentations and written reports;
- knowledge and experience in data collation and analysis in the road vehicle, transport and emissions fields;

The NEPC Service Corporation reserves the right to reject any or all tenders. Tender proposals **(one electronic copy and one hard copy or eight hard copies)** must be submitted to:

Mr Marc Thompson
Project Manager
NEPC Service Corporation
Level 5, 81 Flinders Street
Adelaide SA 5000

Phone: 08 - 8419 1202
Fax: 08 - 8224 0912
E-mail: mthompson@nepc.gov.au

by the time and date specified in the covering letter. Tenders by facsimile or e-mail will be accepted provided the originals are mailed the same day.

9. PROJECT BUDGET

The contract will be awarded on a fixed fee basis.

10. FURTHER INFORMATION

Clarification of any issues relating to this project prior to the awarding of the contract may be obtained by contacting Mr Thompson.

11. TENDER FORMAT

All tenders are to include a table of contents with relevant criteria grouped under the following headings:

1. Introduction
2. Appreciation of the study requirements
3. Experience and expertise applicable to the project
4. Project methodology
5. Capacity to complete the work on time
6. Key personnel: qualifications and experience

The proposal should be no longer than 15 pages (excluding CVs and technical specifications of equipment).

SELECTION OF VEHICLES FOR TESTING

VEHICLE SELECTION CONDITIONS

The general aim of this project is to test a selection of diesel engine vehicles which are representative of the Australian fleet. Table 1 in Appendix 1, which has been derived from the vehicle selection table in Project 2, Phase 2, indicates the vehicle makes from which vehicles and engines are to be selected for testing.

The contractor for Project 4 is required to select a sample of test vehicles in accordance with the makes and age categories listed in the table and the ADR categories described in Section 3 of the project brief and as approved by the Project Manager. Six of the 20 light vehicles tested and 4 of the 12 heavy vehicles tested are to be selected from pre-ADR70/00 1990-95 models, the balance shall come from the 1996-99 group[1].

The contractor is expected to test as wide a variety of make, model and engine capacities within each cell of the table as possible. The contractor is required to comply with the conditions below, in addition to the requirements specified in the Table.

Should difficulties occur during the course of the project which seriously affect the contractor's capacity to meet the requirements of Table 1, or the following conditions, the contractor must obtain written agreement from the Project Manager to vary the requirements.

Conditions

- No more than one vehicle make shall be tested in each cell in the table.
- A range of engine powers/capacities should be tested within each cell.
- The contractor shall contact vehicle manufacturers / suppliers to determine the original standards to which the test vehicle was built, and to determine, if possible, the emission results from the type approval engine fitted to that vehicle. This is likely to be easier with US and European sourced vehicles than with Japanese makes. Many US and European makes will have been certified to domestic standards which are more stringent than the minimum requirements specified in the relevant ADRs.
- In the articulated truck and route bus groups complying with ADR70/00, a mixture of Euro 1 / US 91 and Euro 2 / US 94 vehicles should be tested.

[1] ADR70/00 was phased in over 1995-6, so 1995-6 vehicles will be mixture of pre and post ADR70/00 vehicles. Any 1995 vehicles sourced must not be certified to ADR70/00, and any 1996 vehicles sourced must be certified to ADR70/00.

Table 1 –Vehicle Selection Table

Vehicle Category & GVM/GCM [tonnes]	Vehicle Makes to be Tested	
	Pre ADR70/00	*ADR70/00 Compliant*
	1990-95	*1996-99*
Passenger Car & Off Road Vehicle		
Makes acceptable for testing ➡	Toyota Ford Nissan Mitsubishi Holden Mazda	Toyota Ford Nissan Mitsubishi Holden Mazda
Light Commercial <3.5 t GVM		
Makes acceptable for testing ➡	Isuzu Ford Toyota Mitsubishi	Isuzu Toyota Mitsubishi
Rigid Truck ≥ 3.5-12 t GVM		
Makes acceptable for testing ➡	International Isuzu Mitsubishi Toyota/Hino Ford Mercedes-Benz Nissan-UD Volvo	International Isuzu Mitsubishi Toyota/Hino Mercedes-Benz Nissan-UD Volvo
Rigid Truck ≥ 12 t < 25 t GVM		
Makes acceptable for testing ➡	International Isuzu Mitsubishi Toyota/Hino Ford Mercedes-Benz Nissan-UD Volvo	International Isuzu Mitsubishi Toyota/Hino Mercedes-Benz Nissan-UD Volvo
Articulated Truck ≥ 42.5t **GCM**		
Makes acceptable for testing ➡	International Kenworth Mack Volvo Ford	International Kenworth Mack Volvo Ford Scania
Route Bus ≥ 12t GVM		
Makes acceptable for testing ➡	MAN Mercedes-Benz Scania Volvo	MAN Mercedes-Benz Scania Volvo

DATA TO BE COLLECTED ON THE VEHICLE AND FROM TESTING

1. INSPECTION AND TEST SEQUENCE

1.1 Chassis Dynamometer

The pre-test inspection and testing program shall be conducted in the following sequence:

1. Inspect vehicle and prepare, as required, in accordance with Appendix 2, section 2:

   If suitable for testing, complete report on pre-test inspection and proceed to step 2 below.

   If unsafe or otherwise unsuitable for testing, complete report on pre-test inspection and return vehicle to supplier as soon as possible, with a copy of the report.

2. Conduct the 6-point Inspection detailed in this Appendix 2, section 3.

3. Drain the vehicle fuel tank(s)[1] and store the fuel in suitable 200 L drums.

4. Refuel the vehicle with sufficient quantity of the specified test fuel to ensure the vehicle preconditioning and all the tests specified below can be completed without the need for refuelling.

5. Place vehicle on dynamometer and secure to ensure safe operation.

6. Precondition the vehicle in accordance with the requirements of the relevant benchmark tests specified in Section 3.1 and run standard calibration checks on the emissions sampling and analysis equipment.

7. Connect the vehicle to the emissions sampling and analysis equipment and conduct the relevant benchmark tests specified in Section 3.1 and record the emissions results.

8. Conduct the CUEDC specified in Appendix 3 and record the emissions results.

9. Conduct the specified short test(s).

10. Disconnect emissions sampling and analysis equipment and remove vehicle from the dynamometer.

11. Testing completed.

12. Top up the fuel tank with the waste fuel (provided it is of satisfactory quality), or if this is not sufficient, top up with fuel from a normal commercial outlet.

13. Return vehicle to supplier in accordance with contract requirements.

[1] To minimise the time required for this task, vehicle owners/suppliers should be encouraged to provide vehicles with a minimum quantity of fuel in the fuel tank.

1.2 Engine Dynamometer

The pre-test inspection and testing program shall be conducted in the following sequence:

1. Inspect vehicle , including engine, and prepare, as required, in accordance with Appendix 2, section 2:

   If suitable for testing, complete report on pre-test inspection and proceed to step 2 below.

   If unsafe or otherwise unsuitable for testing, complete report on pre-test inspection and return vehicle to supplier as soon as possible, with a copy of the report.

2. Conduct the 6-point Inspection detailed in Appendix 2, section 3.

3. Remove the engine assembly from the vehicle for engine dynamometer testing.

4. Place engine on the engine dynamometer and ensure it is fitted for safe operation.

5. Connect a specified test fuel supply to the engine and connect the emissions sampling and analysis equipment.

7. Precondition the engine in accordance with the requirements of the benchmark tests specified in Section 3.1 and carry out standard calibration checks on the emissions sampling and analysis equipment.

7. Conduct the benchmark test and record the emissions results.

8. Disconnect the fuel supply and the emissions sampling and analysis equipment and remove the engine from the dynamometer and refit to the vehicle.

9. Return the vehicle to the supplier in accordance with contract requirements.

2. PRE-TEST INSPECTION

The attached check list shall be completed before testing is commenced. Record the details requested, or circle the correct option, as appropriate.

Apart from any adjustments to enable safe operation of the vehicle during the test, the person undertaking the pre-test inspection shall not undertake any work to alter the "as delivered" condition of the vehicle, as this would defeat the objective of assessing real world emissions.

ITEM	INSERT ANSWER or SELECT CORRECT OPTION
Vehicle Details	
Rego Number	
Vehicle Make	
Vehicle Model	
Vehicle Type	*Prime mover / Cab chassis rigid truck / Other rigid truck / Minibus / Route service bus / Other bus / 4WD passenger car derivative*
Engine Make	
Engine Model	
Compliance Plate Date	...../...../.....
VIN	
GVM	.....kg
Tare Weight	.....kg
Vehicle ADR Category	
Odometer reading	.....km (or km since last engine rebuild)
Engine displacement	L
No of cylinders	*4 / 6 / 8 / 12*
Turbocharged	*Yes / No*
Intercooler	*Yes / No*
Fuel system	*Direct injection / Indirect Injection*
Air conditioning	*Yes / No*
General Vehicle / Engine Checks	
Engine oil	Level - *ok/low*
Trans. fluid	Level - *ok/low*
Radiator	Water level - *ok/low*
Battery	Water level - *ok/low* Charge - *ok/low*
Tyres	Condition – *Suitable for testing?*

Engine Settings Checks	
Idle Speed	Manufacturer's Spec.....rpm
Electronic Engine Management System	Operation & type / NA
Drive line	Operation & Condition *Safe for test / unsafe*
Brakes	*Safe for test / unsafe*
Exhaust system	Security - *secure/loose* Leakage - *not leaking/leaking*
Safety Issues	Is the vehicle in a satisfactory condition for testing - *yes/no.*

3. 6 POINT INSPECTION

Item to be Checked	Record Response
Air filter condition ?	clean; moderate; needs replacing
Fuel pump condition Seal intact ? Tampering suspected?	 Yes; no Yes; no
Any missing engine parts ?	Yes; no
Any blue smoke from engine breather & exhaust pipe at idle ?	Yes; no
Turbocharger oil leaks?	Yes; no
Intercooler and compressed air inlet pump hoses condition ?	intact; leaking

4. VEHICLE TESTING EQUIPMENT GUIDELINES

These guidelines on dynamometers and emissions analysis equipment are included to indicate the likely complexity of equipment needed to undertake this project. As indicated in Section 3.2, the requirements of the benchmark tests (refer to UNECE Reg 83/02 or UNECE Reg 49/02) must be met.

Chassis Dynamometer

For the more complex benchmark and CUEDC tests, the dynamometer system will need to be capable of changing the load during each drive cycle so that the vehicle may simulate real world operation by accelerating, decelerating, braking and cruising under the load appropriate for its inertia.

It is recognised that testing of heavy vehicles (ie. those with a test weight greater than 4.5 tonnes) on a transient cycle will impose significant demands on a dynamometer.

For vehicles with a test weight up to 4.5 tonnes the dynamometer shall have a power absorption unit for simulation of road load power and flywheels or other means of simulating inertia weight as specified in the US EPA Code of Federal Regulations (40 CFR Part 86) Section 86.129. Other recognised standard(s) may be used if it applies similar principles of operation and calibration.

For heavier vehicles (ie. those over 4.5 tonnes), the potential tenderer will need to specify in detail the equipment and proposed strategy to be followed to test these vehicles if different to that used for the lighter vehicles. This description should include:

- the location, physical description and specifications of the dynamometer system to be used (including any associated exhaust gas/particulate sampling system);
- the international standards to which this system is designed, maintained and operated;

- the means of simulation of road load power and inertia for the test vehicles; and
- the calibration procedures to be followed throughout the study (the dynamometer and associated sampling system).

In all cases, the dynamometer system should be capable of:

- stable control throughout the cycle being driven and sensitive to light and heavy-duty vehicles;
- testing 4WDs and bogey axle heavy-duty vehicles;
- testing vehicles throughout the ADR weight categories; and
- being calibrated using coast-down procedures to confirm parasitic losses and road-load curves.

The dynamometer must have appropriate software to control the load/speed relationship and a 'drivers aid' to display the appropriate driving trace for assisting a driver in maintaining the correct drive cycle acceleration, deceleration and idle conditions. The 'drivers aid' should provide the total number of errors occurring during the drive cycle.

Exhaust Gas Sampling and Analysis

The mass of particulate in the exhaust should be determined gravimetrically via filtration. The particulate sampling system requires dilution of the exhaust in either of one or two steps to a temperature never greater than 51.7°C (125°F) at the primary sample filter. A backup filter provides a confirmation of sufficient filtering efficiency. Sampling and analysis of total particulate matter should be performed using a single or double dilution tunnel method in conjunction with a CVS as described in the US EPA standards.

Analysis for total hydrocarbons (THC) should be performed directly from the diluted sample stream within the primary dilution tunnel. The THC analytical system requires a heated flame ionisation detector (HFID) and heated sample system designed to maintain the sample temperature at 191°C +/- 6°C to avoid loss of high molecular weight hydrocarbons. A continuously integrated system is required for total hydrocarbon analysis for transient emission testing in order to calculate mass emission rates.

The NO_x analytical system requires a continuously integrated measurement of diluted NO_x. This requires a sampling system that is heated and insulated over its entire length to prevent water condensation, to a minimum temperature 55 C. Unless compensation for varying flow is made, a constant flow system must be used to ensure a representative sample.

The CO and CO_2 analytical system may be either a bag sample/analysis system or a direct sample/analysis system with integration, in a similar manner to which THC and NO_x are measured.

Further requirements are listed below:

- Analysers should conform to the requirements of an internationally recognised organisation such as UN ECE or SAE. Use of workshop grade analysers is unacceptable.
- Temperatures within the sample path for all analytes should be maintained at appropriate temperatures to avoid water condensation or loss of analyte. Any particulate or water filtration system should also be designed to ensure no loss of analyte.
- The operation of the system shall demonstrate a rigorous calibration and instrument optimisation regime. All calibration gases should be supplied with analysis certificates from a laboratory accredited by NATA or an equivalent recognised organisation. The analysers should always be operated using the highest measuring ranges to achieve optimum sensitivity and accuracy.

In addition, the test vehicles for chassis dynamometer tests will have a variety of exhaust types (straight, bent, vertical, horizontal, with / without raincaps, etc) and a range of exhaust pipe diameters. The successful tenderer will need to have the capacity to effectively connect exhaust sampling lines to this variety of exhaust outlets.

PROCEDURES FOR LABARATORY EMISSION TESTING

Appendix 3 consists of:

1. Preparatory Work, Project 2: In-service Emissions Performance, Phase 1: Drive Cycles – Final Report, February 1999, Volumes 1 & 2; and
2. One 3 ½ inch floppy disk.

Complex Drive Cycles

A detailed description of the complex drive cycles are provided in an Excel file on floppy disk.

Discussion of drive cycles are provided in Preparatory Work, Project 2: In-service Emissions Performance, Phase 1: Drive Cycles – Final Report, February 1999, Volumes 1 & 2.

For each vehicle tested, separate measurements of each nominated emission and fuel consumption will be made over the portion of the appropriate CUEDC that represents each of the four traffic flow conditions of the cycle. An appropriately weighted measurement collected over the entire cycle (all four traffic flow conditions) will also be provided for each of the nominated emissions and for fuel consumption. The measurements will be expressed in total grams per kilometre for emissions and litres per 100 kilometres for fuel consumption.

The nominated emissions to be measured are:

- oxides of nitrogen;
- total particles;
- total hydrocarbons; and
- visible smoke.

In-service Emissions Assessment Procedures

Details of the in-service emissions assessment procedures are provided in Volume 2 as listed below:

- SAE J1667 Attachment 2
- D550 Attachment 3
- Full Load 2 speed (ADR30) Attachment 4
- Lug Down (State of Colorado Regulation 12) Attachment 5
- DT80 Full Acceleration 80km / hr Cruise Test Attachment 6
- 10 Second Smoke Rule Attachment 7