

# **APPENDIX IV**

## **TESTING PHASE DETAIL**

## ***Literature Review***

The literature review was undertaken to provide a baseline of knowledge on the relationship between fuel volatility and motor vehicle evaporative emissions. There was some scope for changing the project's experimental design from the literature review, but this was not necessary.

## ***Sample Design***

For the petrol volatility component, 4 vehicles (2 pre-1986 and 2 post-1986) had evaporative emissions tests completed using 4 different volatility fuel types for the 2 categories of vehicle. The fuel types were the NISE leaded and unleaded fuel for the canister sequence. In total, there were eight types of petrol. These were based on the NISE leaded and unleaded fuel, and their volatility modified stepwise in decreasing volatility. The vehicle and especially the evaporative emission control system, in particular the carbon canister, were brought back to a baseline state between each evaporative emission test by securing vapour lines and continuously weighing/purging/re-weighing the carbon canister to achieve a reasonable base weight. The base weight was reached by a two hour purge using 100 kPa of air pressure.

For the carbon canister component, 9 vehicles (5 pre-1986 and 4 post-1986) had a sequence of evaporative emissions tests completed; the first with the in-situ carbon canister in its deteriorated state (artificially purged) and the second with a replaced "new" carbon canister of design specifications recommended by each vehicle's manufacturer (unpurged/as new). Where a canister is no longer available, the manufacturer's advice was sought on an appropriate alternative.

## ***Vehicle Sourcing***

Vehicles that had undergone evaporative emissions testing as part of the FORS National In-service Emissions Project NISE (EPA(Vic) testing component) were primarily used to source vehicles for this project. Vehicle owners were informed by EPA(Vic) of the desire to have their vehicle tested. Those that offered a vehicle for testing gained the use of a replacement vehicle, a new carbon canister (for the canister evaluation component), a car care kit (thank you gift for participating in the project) and the vehicle was returned with a full tank of fuel as well as being washed and vacuumed.

Vehicles with low and/or complying evaporative emission results were targeted for the petrol volatility component. The proper operation of the purge control valve was used to assess the appropriateness of test vehicles. Vehicles with results slightly higher than the design limits were targeted for the canister component. Vehicles with very high evaporative emission results from the NISE Study were not targeted as they may have had system faults that were not able to be fixed within the time constraints of this project.

## ***Vehicle Testing***

Vehicles were inspected to ensure that they were acceptable for testing in terms of road worthiness and the evaporative emission control system (which had to be visually in-tact). The fuel tank cap was undone to verify a pressure seal.

All vehicles were driven to the EPA(Vic)'s Vehicle Testing Station at Altona where they underwent initial reception and preparation for testing - a copy of the proforma sheet to be used by EPA(Vic) staff for this task is attached at the end of this Appendix. Particular attention was paid to the evaporative emission control components and their proper connection and functioning. Other items requiring attention, (ie fluid top ups, spark plug replacement etc) were addressed as needed.

The evaporative emission testing procedures to be used were those defined in ADR37/00. Exceptions to this procedure were using a surface mounted RTD, interrupting the evaporative emission control system to weigh the canister after the heat build phase of the test, and connecting a purge flow meter for the pre-condition drive. Naturally, the use of nominated test fuels was also an exception.

All vehicles had a test envelope initiated and completed for each evaporative emission test. A copy of the front of such an envelope is attached at the end of this Appendix.

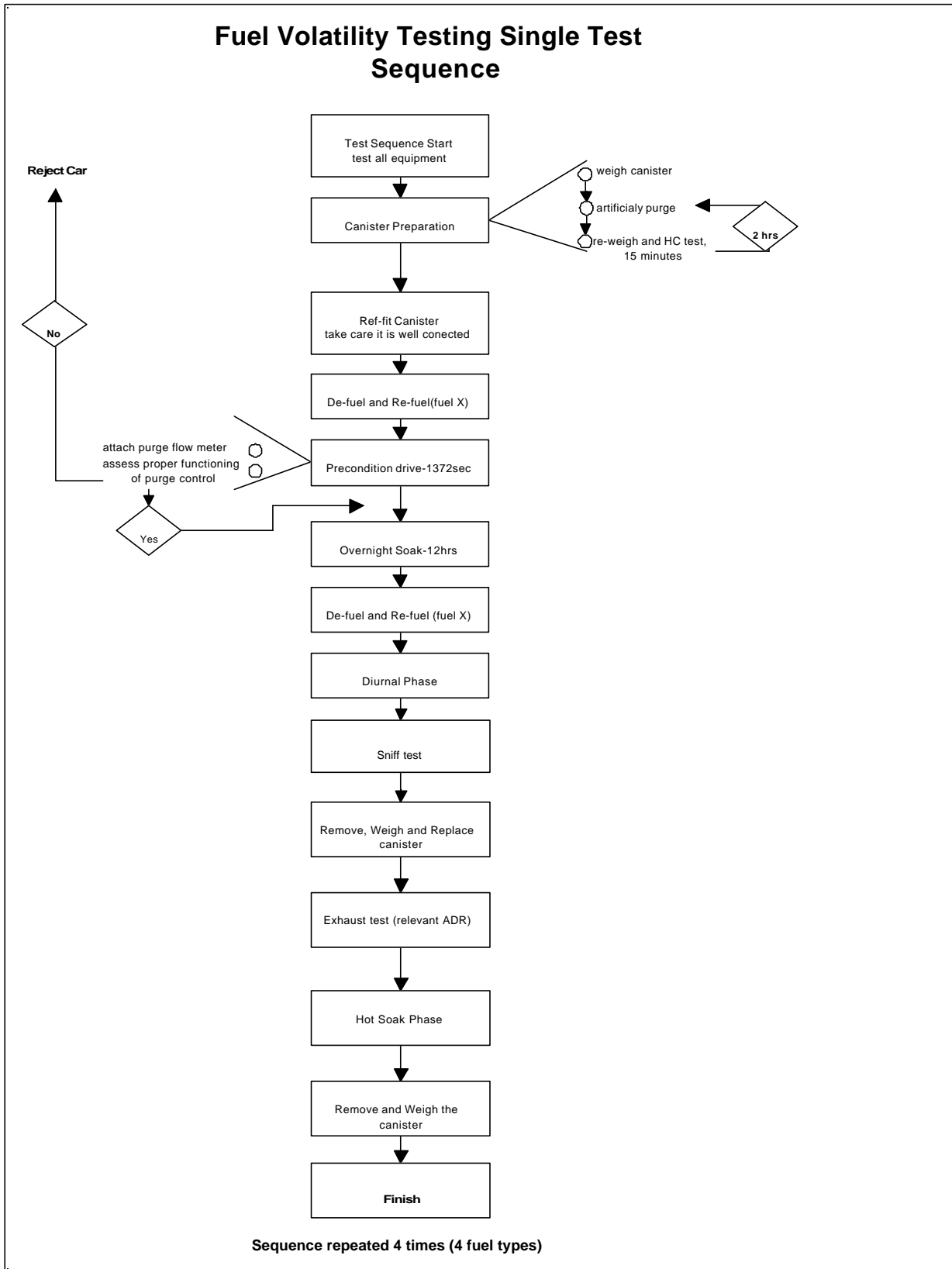
### **Volatility Component Testing Sequence:**

1. The canister was removed and weighed, then artificially purged (passing compressed air -100kPa- through canister) and re-weighed. The weight was recorded, as were the hydrocarbon emissions using an OTIS four gas analyser. This was repeated every 15 minutes for 2 hours. The figures at the end of the 2 hours were used as the baseline condition for the test vehicle's canister.
2. The canister was re-fitted to the test vehicle, particular care was taken to properly connect

3. The vehicle was then de-fuelled and re-fuelled with chilled test fuel number X (LP/ULP and volatility as appropriate)
4. The ignition timing and idle speed, idle components of the exhaust for the following; carbon monoxide, hydrocarbons, oxygen and carbon dioxide were measured and recorded [on the test envelope].
5. The Pre-condition drive over 1372 seconds of the ADR37/00 drive cycle was carried out with the purge flow meter attached. This was to assess the proper functioning of the purge control. The purge flow volume (in litres) was noted on the test envelope.
6. The vehicle was soaked overnight.
7. The next day, test vehicle was then de-fuelled and re-fuelled with chilled test fuel number X.
8. The diurnal phase of the evaporative emissions test was then undertaken.
9. At the completion of the diurnal phase of the test, the carbon canister was removed and weighed. The value was noted on the test envelope and then the canister re-fitted to the vehicle. Care was taken to properly connect.
10. The exhaust emissions component of the test was then undertaken.
11. The hot soak phase of the evaporative emissions component was then undertaken.
12. The canister was removed, weighed again and re-fitted to the vehicle.

Steps 1 through to 12 were repeated until the 4 fuel types were covered for each test vehicle. At the completion of the 4 fuel types the vehicle was washed and vacuumed and filled with petrol, prior to its return to the owner.

Flow Chart A-IV.1 - Petrol Volatility Testing steps



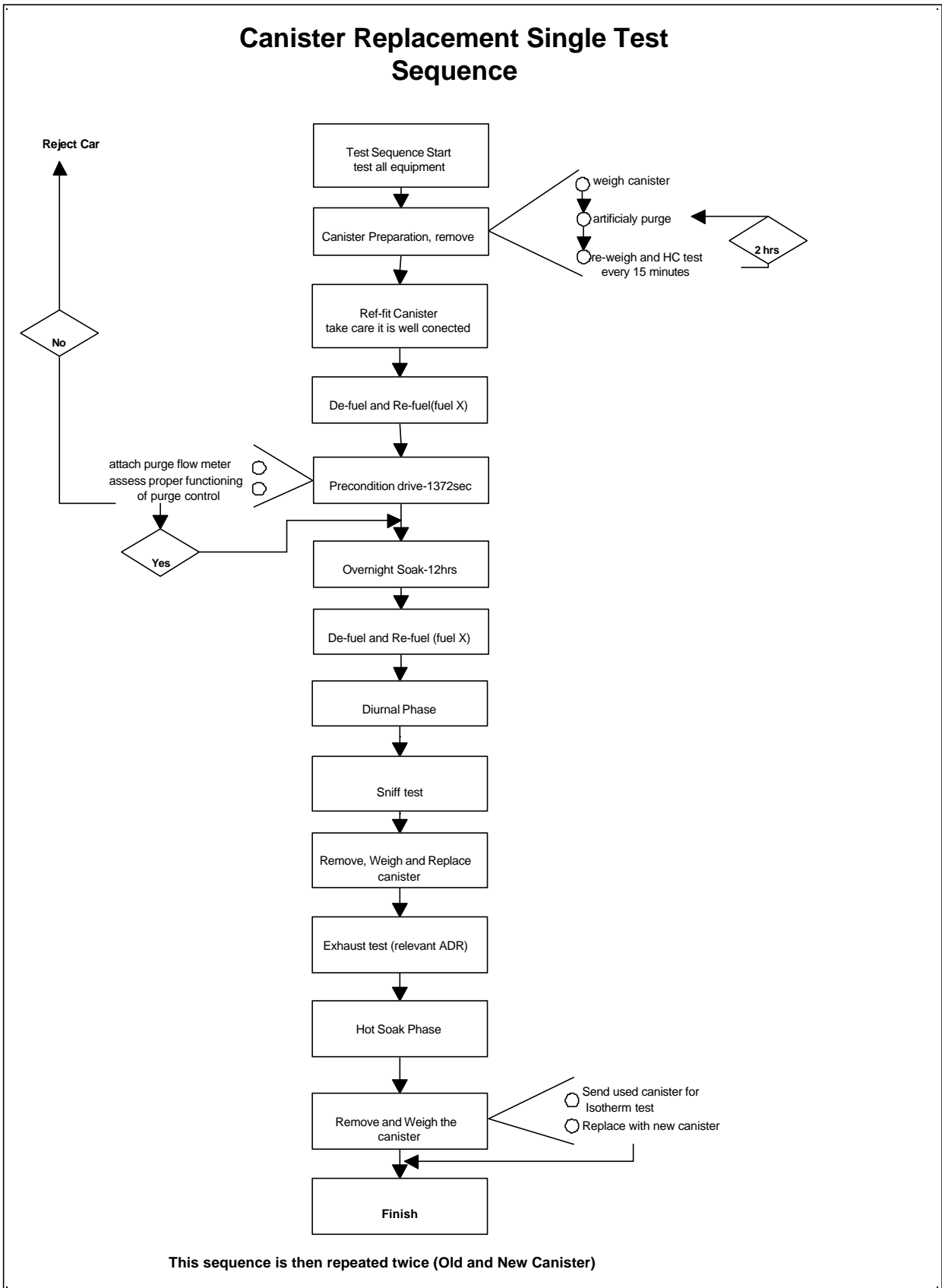
### Canister Component Testing Sequence:

1. The in-situ or old canister was removed and weighed, then artificially purged (passing compressed air -100kPa-through canister) and re-weighed. The weight was recorded, as were the hydrocarbon emissions using an OTIS four gas analyser. This was repeated every 15 minutes for 2 hours. The figures at the end of the 2 hours were used as the baseline condition for the test vehicle's canister. The canister was labelled with its vehicle's registration number and whether it is old or new.  

[Note: This initial canister pre purging was only carried out on the old canister.]
2. The canister was re-fitted to the test vehicle, particular care was taken to properly connect.
3. The vehicle was de-fuelled and re-fuelled with chilled NISE fuel (LP/ULP as appropriate).
4. The ignition timing and idle speed, idle components of the exhaust for the following; carbon monoxide, hydrocarbons, oxygen and carbon dioxide were measured and recorded.
5. The pre-condition drive over 1372 seconds of the ADR37/00 drive cycle was carried out with the purge flow meter attached. This was to assess the proper functioning of the purge control. The purge flow volume (in litres) was noted on the test envelope.
6. The vehicle was soaked overnight.
7. The next day, the vehicle was de-fuelled and re-fuelled with chilled NISE test fuel as appropriate.
8. The diurnal phase of the evaporative emissions test was then undertaken and the results recorded.
9. At the completion of the diurnal phase of the test, the carbon canister was removed and weighed. The value was noted on the test envelope and then the canister re-fitted to the vehicle. Care was taken to properly connect.
10. The exhaust emissions component of the test was then undertaken, this followed the relevant ADR37/00.
11. The hot soak phase of the evaporative emissions component was then undertaken and the results recorded.
12. The canister was then removed and a new canister fitted to the vehicle.

Steps 2 through to 12 were repeated with the new canister. At the completion of both evaporative emissions tests (old and new canister), both canisters were sent to CSIRO for adsorption isotherm testing. A second new canister was installed on the test vehicle prior to return to the client. The vehicle was also vacuumed, washed and refuelled

Flow Chart A-IV.2 - Carbon Canister Testing Steps



### ***Compilation of Test Results***

EPA(Vic) compiled the results from the 2 experimental components. The data was summarised in Microsoft Excel spreadsheets.

### ***Assessment of Photochemical Smog implications from the fuel volatility and canister replacement components***

EPA(Vic) assessed the implications for photochemical smog from the fuel volatility and canister components. This was done by drawing on the emissions inventory compilation and air emissions modelling expertise of EPA(Vic).

These preliminary assessments were in terms of quantitative changes in total hydrocarbon emissions (eg. X'000 tonnes per year changes) as well as photochemical smog scenarios

### ***Assessment of the cost implications for the petroleum industry in view of changes to fuel volatility and the vehicle owners in terms of carbon canister replacement***

AIP provided data on the cost implications for the proposed recommendations on changes to the volatility of commercially available fuel.

FCAI provided data on the cost implications for any proposed recommendations on regular replacement programs for carbon canisters.

### ***Reporting***

EPA(Vic) wrote the final report drawing together all phases of the project. Comments were sought from members of the Steering Committee. The formatting was aligned with that used for the NISE Study in order to provide for a complete study set.

### ***Documentation and Administration***

- ATTACHMENT 1 - VEHICLE PREPARATION CHECKLIST, USED TO ENSURE ALL THE VEHICLES INFORMATION WAS NOTED.
- ATTACHMENT 2 - TEST ENVELOPE, SHOWS A SUMMARY OF THE INFORMATION RECORDED FOR A PARTICULAR TEST.
- ATTACHMENT 3 - HANDOVER FORM FOR REPLACEMENT VEHICLE.
- ATTACHMENT 4 - HANDOVER FORM FOR TEST VEHICLE

**VEHICLE PREPARATION CHECKLIST**

Vehicle Registration No.				
<b>History</b>	Serviced by		Phone	
	Last Serviced	/ /	Km	
<b>Fuel System</b>	Injected		Carburetted	
	TBI	MPI	No. of carb.	No. of barrels/carb
<b>Cooling Fan</b>	Thermatic	Clutch	Direct Drive	
<b>Tyres</b>	Manufacturer		Model	Size
	Condition	Good	Average	Poor
<b>Spark Plugs</b>	Condition	good / ok / poor	Replaced yes / no	Gap mm
<b>Distributor</b>	Condition or N/A	good / ok / poor	Gap / Dwell	mm/deg.
<b>Coil</b>	Condition			
<b>Timing</b>	Specified	o	Measured / Adjusted	o
<b>Idle Mixture</b>	Specified or N/A		Measured / Adjusted	
	CO %	HC ppm	CO %	HC ppm
	O2 %	CO2 %	O2 %	CO2 %
<b>Idle Speed</b>	Specified	rpm	Measured / Adjusted	rpm
<b>Electronic Engine Management System</b>	Operation and type or N/A			
<b>Engine Oil</b>	Top up as required	OK / Top up	litre	SAE Grade
<b>Transmission Fluid</b>	Top up as required	OK / Top up	litre	SAE Grade
<b>Water levels</b>	Top up as required	OK / Top up	litre	
<b>Battery</b>	Condition			
<b>Exhaust System</b>	Security & leakage			
<b>Brakes</b>	Serviceability / Drag			
<b>Emission Controls</b>	Canister	Correctly Connected		
	Fuel Cap	Correct and pressure seal		
	Vapour Line	Condition & correctly connected		
	EGR	Correct / Incorrect Operation		
	Oxygen sensor	Correct / Incorrect Operation		
	Catalytic converter	Correct / Incorrect Operation		
<b>Total Vehicle</b>	Defective items			



**ENVIRONMENT PROTECTION AUTHORITY**  
**of VICTORIA**  
 VEHICLE TESTING STATION  
 QUEEN ST. ALTONA 3018  
 Tel.(03)39951111

EMISSIONS TEST RECORD		Date TESTED
PASSED	FAILED	TEST RECORD No.
	Date PROHIBITED	TEST/CYCLE
	Date CLEARED	
MAKE	MODEL	OWNER/DEPT.
TEST DESC	TEST No. DATE	ADDRESS
REG/CHASSIS No.		
MONTH/YEAR	26   27   27/A/B/C   30   36   37	
BODY - SED/S WAG/FCPV/4WD/VAN/UTIL/.....	TEST INSTRUCTIONS/PROGRAM	
ODOMETER	km	COLOUR
TRANS-A M 3 4 5	AIR-CONDITIONING	YES/NO
AXLE RATIO	:1	FIRST GEAR RATIO
	Spec.	Meas.
IDLE SPEED	r.p.m.	
IDLE IGNITION TIMING	°	
DWELL ANGLE	°	
IDLE CARBON MONOXIDE	%	
IDLE HYDROCARBONS	ppm	
IDLE OXYGEN	%	
IDLE CARBON DIOXIDE	%	
No. of CYLINDERS	4/6/8	
TYPE	M-LINE/FLAT/VEE/ROTARY	
CAPACITY	litres	POWER
FUEL	TEST UNLEADED/LEADED/LPG/DIESEL	KW
	DUAL(.....) OTHER(.....)	
CHOKE M A PROCEDURE	None Rec Owners Man.	
CHANGE SPEEDS	None Rec. 1/2   2/3   3/4   4/5	
FUEL TANK CAPACITY	litres	
	Diagram of Fuel Tank Contents (E to F)	FUEL MASS (.....litres x0.75) kg
	REFERENCE MASS	+ 136 kg
	EQUIVALENT INERTIA	kg
	SOAK Time Start	
	Date DESPATCHED	
	Checked by	
	COMMENTS	
		HC g/km 1 Bag 3 Bag HWFET
		CO g/km 1 Bag 3 Bag HWFET
		CO2 g/km 1 Bag 3 Bag HWFET
		NOx g/km 1 Bag 3 Bag HWFET
		Fuel Consumption litres/100km 1 Bag 3 Bag HWFET
		EVAP.(S.H.E.D.)
		Breathing Loss + g.
		Hot Soak g.
		TOTAL g.

# **FEDERAL OFFICE OF ROAD SAFETY**

## **NATIONAL IN-SERVICE VEHICLE STUDY**

### **REPLACEMENT VEHICLE**

#### **Handover : Conditions of Assignment**

**1. Details to be Completed prior to Handover**

Company Providing Vehicle .....

Make of Car.....Engine No.....

Year/Model..... Registration No.....

Period of Assignment From...../...../..... To...../...../.....

Odometer Reading .....

Condition of vehicle on Handover  Not Damaged  Damaged (specify)

**Statement of Indemnity and Conditions of Assignment**

During the period of assignment, I/We hereby indemnify .....from all or any fines or penalties which may be occasioned by the operation of the vehicle in breach of any road, traffic, motor vehicle or parking laws.

During the period of assignment, I/We hereby indemnify ..... against all claims, actions or proceedings that may be incurred in respect of the death of, or bodily injury to, any person, (except to the extent to which the cause may be covered by third party insurance in respect of the vehicle) and all loss, damage or destruction to any property including the vehicle arising directly or indirectly from the possession, use or operation of the vehicle (other than that following theft and before its recovery) by:

1. an unlicensed driver, or
2. a driver under the influence of any drug or intoxicating liquor, or
3. a driver whose blood alcohol concentration is above the prescribed limit by applicable legislation, or
4. a driver who refuses to submit to a blood alcohol test when requested to do so.

It is understood that .....indemnifies me/us against all liabilities, costs and expenses falling outside the indemnities by me/us arising from the use or possession of the vehicle by me/us during the period the vehicle is in my/our possession, including any loss or damage to property not owned by ..... except liabilities, costs and expenses of a kind covered by compulsory third party insurance.

I/we shall immediately inform ..... of any damage or injury to persons or property caused by the vehicle, and of any theft, loss or damage occasioned to the vehicle in an accident, and shall complete such claim forms, execute such documents and testify in such suits and actions in law or in equity, in connection with such matter as may be requested by .....

Assignee's Signature.....Date & Time of Handover: .....am/pm on ...../...../.....

**2. Details to be Completed on Return**

Odometer Reading on Return.....

Condition of vehicle on Handover...  Not Damaged  Damaged (specify)

Assignee's Signature.....Date & Time of Return:.....am/pm on ...../...../.....

