COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DESIGN RULE 27A
FOR
VEHICLE EMISSION CONTROL
As Endorsed by the
Australian Transport Advisory Council

The intention of this Australian Design Rule is to limit fuel evaporative and exhaust emissions from motor vehicles in order to reduce air pollution.

The Australian Transport Advisory Council has recommended to Commonwealth, State and Territory Governments that all motor vehicles specified below equipped with petrol fuelled spark ignition internal combustion engines except those also equipped to use liquified petroleum gas as an alternative fuel to petrol and those with an engine displacement of less than 850 millilitres, shall comply with Australian Design Rule 27A - Vehicle Emission Control.

VEHICLE CATEGORY	RULE	AMENDMENT	
	MANUFACTURED ON OR AFTER		
	27A		
Passenger Cars			
Forward Control Passenger Vehicles up to 8 seats	N/A		
9 seats	N/A		
Other Passenger Cars	1 July 1976		
Passenger Car Derivatives	1 July 1976		
Multi-Purpose Passenger Cars	N/A		
Omnibuses up to 3.5 tonnes GVM			
up to 12 seats	N/A		
over 12 seats	N/A		
up to 4.5 tonnes GVM	N/A		
over 4.5 tonnes GVM	N/A		
Motorcycles	N/A		
Mopeds	N/A		
Specially Constructed Vehicles	N/A		
Other Vehicles not listed above			
up to 4.5 tonnes GVM	N/A		
over 4.5 tonnes GVM	N/A		

N/A - Not Applicable
GROSS VEHICLE MASS - Abbreviated to 'GVM'

The Australian Transport Advisory Council has also recommended to Commonwealth, State and Territory Governments that motor vehicles which comply with the requirements of ADR 27B - Vehicle Emission Control need not comply with the requirements of ADR 27A.

The Australian Transport Advisory Council has also recommended to Commonwealth, State and Territory Governments that motor vehicles manufactured after 1 July 1985 which comply with the requirements of ADR 37 need not comply with the requirements of ADR 27A.

The Australian Transport Advisory Council has also recommended to Commonwealth, State and Territory Governments that the option available in ADR 27A - Vehicle Engine Emission Control, for motor vehicles which use unleaded petrol exclusively, shall only apply to motor vehicles manufactured on or after 1 July 1985.

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AUSTRALIAN DESIGN RULE NO. 27A - VEHICLE EMISSION CONTROL

27A.1 Definitions

27A.1.1 'Administrator' - means the Australian Motor Vehicle Certification Board or a person to whom the Board has delegated, by instrument in writing revocable at will, the powers and functions of the Administrator under this Design Rule.

27A.1.2 'Approved' - means approved by the Administrator.

27A.1.3 'Engine Family' - means a basic classification of vehicles having similar characteristics as defined in Clauses 27A.3.5.1 to 27A.3.5.4.

27A.1.4 'Fuel System' - means the combination of fuel tank, fuel pump, fuel lines and carburettor or fuel injection components, and includes all fuel system vents and fuel evaporative emission control systems.

27A.1.5 'Fuel Evaporative Emissions' - means vaporised fuel emitted to the atmosphere from the fuel system of a motor vehicle.

27A.1.6 'Fuel Evaporative Emission Control System' - means a system which incorporates a particular principle of operation to control or cause the reduction of fuel evaporative emissions.

27A.1.7 'Hot Soak Loss' - means fuel evaporative emissions during the one hour period which begins immediately the engine is turned off.

27A.1.8 'Diurnal Breathing Loss' - means the fuel evaporative emissions as a result of the daily range of temperature to which the fuel system is exposed.

27A.1.9 'Running Loss' - means the fuel evaporative emissions resulting from an average trip in an urban area or the simulation of such a trip in accordance with this Design Rule.

27A.1.10 'ASTM' - means American Society for Testing and Materials.

'CO' - means carbon monoxide.

'HC' - means hydrocarbons.

'NOx' - means oxides of nitrogen.

'IP' - means The Institute of Petroleum.

27A.1.11 '0 km' - means the point at which testing and controlled distance accumulation commences subject to the requirements of Clause 27A.3.4.

27A.1.12 'Test Vehicle' - means an Emission Data Vehicle or a Durability Data Vehicle.

27A.1.13 'Emission Data Vehicle' - means a vehicle which is operated and tested to determine its emissions after distance accumulation of 6 400 km.

27A.1.14 'Durability Data Vehicle' - means a vehicle which is driven for 80 000 km under controlled conditions and tested in order to establish the durability of the emission control systems.

27A.1.15 'Reference Mass' - means the mass of the vehicle with a full capacity of lubricating oil, coolant and fuel but without occupants or options, except those options which are essential to the test, plus a mass of 136 kg.

27A.1.16 'Engine-System Combination' - means an engine family - exhaust emission control system - fuel evaporative emission control system (where applicable) combination.

27A.1.17 'Useful Life' - means a period of use of 5 years or 80 000 km, whichever first occurs.

27A.1.18 'Unleaded Petrol' - means petrol (or motor spirit) containing not more than 0.013 gram of lead per litre and not more than 0.0013 gram of phosphorus per litre.

27A.1.19 'Unleaded Petrol - engined Vehicle' - means a vehicle coming within the definition of this Design Rule and which has been designed, constructed and is recommended by the vehicle manufacturer to be operated using unleaded petrol exclusively.

27A.1.20 'Other Vehicle' - means a vehicle coming within the definition * of this Design Rule, other than an unleaded petrol-engined vehicle (refer Definitions Clause 27A.1.19).

27A.1.21 'Leaded Petrol' means petrol (or motor spirit) which is produced with the use of any lead additive or which contains more than 0.013 gram of lead per litre or more than 0.0013 gram of phosphorus per litre.

27A.1.22 'Lead Additive' means any substance containing lead or lead compounds.

* Amended July, 1983

27A.2 REQUIREMENTS

27A.2.1 Except for 0 km tests, tests conducted during an emission stabilisation period, and individual tests conducted on durability data vehicles, every motor vehicle, when tested in accordance with the requirements of Clauses 27A.6 to 27A.9 inclusive, shall be such that the level of emissions does not exceed:-

(i) for fuel evaporative emissions, Hydrocarbons - 2 grams per test.

(ii) for exhaust emissions,

(a) Hydrocarbons - 2.1 grams per vehicle kilometre

(b) Carbon monoxide - 24.2 grams per vehicle kilometre

(c) Oxides of nitrogen - 1.9 grams per vehicle kilometre.

The emission stabilisation period shall be less than 6 400 km and shall be approved by the Administrator.

27A.2.2 Every motor vehicle shall have a legible label in a readily visible position in the engine compartment. The label shall be permenently affixed and shall state directly or by reference, the engine tune-up specifications and adjustments, including idle speed, ignition timing and the idle air/fuel mixture setting procedure and value. The specifications shall state the transmission position during tune-up and any accessories which should be in operation.

27A.2.3 Every motor vehicle shall be tuned and adjusted in accordance with the label referred to in Clause 27A.2.2.

27A.2.4. With every motor vehicle the manufacturer shall provide written instructions for the maintenance and use of the vehicle as may be reasonable and necessary to assure the proper functioning of emission control systems.

27A.2.5 Requirements for fuel label

Every unleaded petrol-engined vehicle (refer Definitions Clause 27A.1.19) shall have the words "UNLEADED PETROL ONLY" or "UNLEADED FUEL ONLY" on a durable label or by other durable means permanently affixed to the area immediately adjacent to the petrol filler inlet(s), on the door to the filler inlet compartment, or within 150 mm of the door to the filler inlet compartment, or on or within 150 m,m of the filler inlet cap, readily visible to any person intending to refuel the vehicle. The lettering shall be legible and in capital letters no smaller than 6.0 mm high.

Alternative wording or location may be used, if approved.

27A.2.6. Requirements for petrol filler inlet

The following requirements shall apply to every unleaded petrol-engined vehicle:

(a) Unleaded petrol-engined vehicles (refer Definitions Clause 27A.1.19) shall be equipped with a petrol tank filler inlet assembly which prevents the insertion of a nozzle having a spout with an external diameter of 23.6 mm or greater (leaded petrol nozzle) and allows the insertion of a nozzle have in a spout with an external diameter of 21.34 mm or less (unleaded petrol nozzle). *

For details of nozzles, refer Appendix 1.

(b) The design and construction of the filler inlet assembly shall be such that it is not possible for it to be readily altered to allow the insertion of a leaded petrol nozzle having a spout with an external diameter of 23.6 mm or greater, without causing such damage as would require its replacement or major repair to enable it to be restored to the design condition.

(c) The filler inlet assembly shall be designed to pass not more than 700 ml of petrol into the tank when the introduction of petrol into such filler inlet assembly is attempted from a leaded petrol nozzle complying with the characteristics specified in Appendix I.

(d) A test shall be conducted to establish compliance with Clause 27A.2.6(c) using a test fixture which positions the filler inlet assembly in the same position as it is installed in the vehicle. For the purpose of this test, an attempted introduction shall be conducted by inserting a leaded petrol nozzle such that its automatic shutoff

* Amended July 1983

vacuum post is at various depths within the filler inlet, except those locations which cause spillage (not including splash back) outside the filler inlet assembly * shall not be used. The nozzle may have any orientation within the filler inlet assembly which may reasonably be expected to be encountered in use. The nozzle valve shall be fully and rapidly opened to a 30 $\pm$ 4 litres/minute flow setting.

* Amended July 1983

27A.3 DETERMINATION OF COMPLIANCE AND SELECTION OF TEST VEHICLES

27A.3.1 Compliance shall be established to the satisfaction of the Administrator in accordance with this Design Rule.

27A.3.2 In determining whether compliance has been established, the Administrator shall accept any approvals issued by the Environmental Protection Agency of the United States of America with regard to Federal Regulation Part 85 - Control of Air Pollution, provided that such approvals are referenced to 1973 model year vehicles. Approvals referred to other model years may be accepted at the discretion of the Administrator. Furthermore, the Administrator may accept, at his discretion, approvals issued with respect to other standards equal to or more stringent than this Design Rule.

27A.3.3 Types of test vehicles shall be selected by the Administrator, in accordance with the selection procedure specified in Clauses 27A.3.5.1 to 27A.3.5.4 inclusive. The manufacturer shall provide identification information prior to initiating testing on the selected test vehicle.

27A.3.4 Unless otherwise approved, the engine and fuel system of any vehicle proposed by the manufacturer as a test vehicle shall be untested with respect to compliance with this Design Rule and the engine shall have been run for not more than the equivalent of 150 km subsequent to normal production and predelivery procedures. The vehicle may be checked to ensure that all components are within specification.

27A.3.5 For the purpose of establishing compliance, the Administrator shall not have the power to select more test vehicles than the numbers indicated by the selection methods defined in this Design Rule.

27A.3.5.1 Vehicles shall be divided into groups according to engine family. To be classed in the same engine family all the conditions listed for (i) and (ii) below shall be met:

(i) they are identical with respect to

(a) the nominal bore centre to centre dimensions,

(b) the nominal dimension from the centreline of the camshaft to the centreline of the crankshaft,

(c) the nominal dimension from the centreline of the crankshaft to the top of the cylinder block head face,

(d) the number of cylinders and their configuration,

(e) the nominal location of the intake and exhaust valves,

(f) the method of air aspiration (i.e. natural or forced),

(g) the combustion cycle,

(h) Catalytic converter characteristics,

(i) thermal reactor characteristics, *

(j) the method of fuel intake. If by carburettion there shall be no variation in the number of carburettors, number of barrels or principle of operation. If by fuel injection, there shall be no variation in the type of flow, i.e. it shall be either continuous or non-continuous,

(ii) Any variations in nominal engine displacement, inlet valve head diameter and exhaust valve head diameter, are within the following limits

(a) for nominal engine displacement, 20 percent of the highest displacement value for a displacement of 2 000 millilitres or less or, 850 millilitres for a displacement above 2 000 millilitres,

(b) for inlet valve head diameter, 3.2 mm,

(c) for exhaust valve head diameter, 3.2 mm.

27A.3.5.2 Engines meeting the conditions of Clause 27A.3.5.1 may be further divided into different engine families if the Administrator determines that they may have different emission characteristics. This determination will be based upon consideration of the intake manifold induction port size and configuration.

27A.3.5.3 Engine families based on other engine features may be established by the Administrator if the manufacturer can demonstrate that the engines incorporating such features have substantially similar emission characteristics.

27A.3.5.4 In cases where the engines are of a type which cannot be classified according to the criteria of Clause 27A.3.5.1, the Administrator shall establish engine families based on features considered to be most related to their emission characteristics.

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27A.3.5.5 Motor vehicles shall be selected to be operated and tested for emission data as follows:

(i) Vehicles of each engine family will be divided into engine displacement - exhaust emission control system - fuel evaporative emission control system - combinations. The combinations will be arranged in order according to the manufacturer's projected annual sales volume. One vehicle of each combination will be selected in decreasing order of sales volume until 70 per cent of the projected annual sales of the engine family is represented or until a maximum of 4 vehicles has been selected. If any single combination represents 70 per cent or more, then 2 vehicles of that combination may be selected. The actual test vehicles will be specified by the Administrator as to transmission type, fuel system and inertia class;

(ii) The Administrator may select a maximum of 2 additional vehicles within each engine family based upon features indicating that they may have the highest emission levels of the vehicles in that engine family. In selecting these vehicles, the Administrator will consider such features as the emission control characteristics, ignition system characteristics, fuel system, rated power, torque, compression ratio, inertia class, transmission options and axle ratios;

(iii) If the vehicles selected in accordance with paragraphs (i) and (ii) above do not represent each engine family - exhaust emission control system - fuel evaporative emission control system combination (hereinafter referred to as 'engine-system combination'), then one vehicle of each engine-system combination not represented may be selected by the Administrator. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with the control system combination in the engine family and will be designated by the Administrator as to transmission type, fuel system and inertia class;

(iv) After giving notice of intention, the manufacturer may elect to operate additional emission data vehicles to represent any engine-system combination. Emission test data from their vehicles may be taken into account in determining compliance with this Design Rule.

27A.3.5.6 Vehicles shall be selected to be operated and tested for durability data as follows:

(i) One durability data vehicle will be selected by the Administrator to represent each engine-system combination. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with that control system combination in that engine family and will be designated by the Administrator as to transmission type, fuel system and inertia class.

If an exhaust emission control system - fuel evaporative emission control system combination - is used in only one engine family, an additional vehicle using that combination in that family may be selected.

(ii) The manufacturer may elect to operate and test additional vehicles to represent any engine-system combination. The additional vehicles must be of the same engine displacement, transmission type, fuel system and inertia class as the vehicle selected for that engine-system combination in accordance with Clause 27A.3.5.6(i). Notice of an intention to operate and test additional vehicles shall be given to the Administrator.

27A.3.5.7 Any manufacturer whose projected annual sales of new motor vehicles of a particular model subject to the requirements of this Design Rule, is less than 1 000 vehicles may request a reduction in the number of test vehicles determined in accordance with Clauses 27A.3.5.5 and 27A.3.5.6 above. The Administrator may agree to such lesser number as he determines would meet the intent of this Design Rule.

27A.4 TEST FLEET REQUIREMENTS

The emission standards specified in Clause 27A.2.1 apply to vehicles over their useful life. In order to estimate the emissions of emission data vehicles at 80 000 km, deterioration factors shall be established to relate emissions at 80 000 km to those at 6 400 km for each engine-system combination. Deterioration factors shall be either:

(i) those stated in Clause 27A.4.1; or

(ii) as determined by operating durability data vehicles in accordance with Clause 27A.4.2 to 27A.4.5.

27A.4.1 The manufacturer may elect to not operate and test durability data vehicles. In this case, it shall be assumed that the deterioration factors are:

(i) for fuel evaporative emissions, 0.2 grams (additive);

(ii) for exhaust emissions, for passenger cars and derivatives:

	Vehicles manufactured on or after	
	1.7.76	1.1.78
(a) Hydrocarbons	1.0	1.1
(b) Carbon monoxide	1.0	1.1
(c) Oxides of nitrogen	1.0	1.1

(iii) for exhaust emissions, for vehicles other than passenger cars and derivatives: *

(a) Hydrocarbons	1.0
(b) Carbon monoxide	1.0
(c) Oxides of nitrogen	1.0

27A.4.2 Unless otherwise approved, durability data vehicles to be operated and tested shall be subjected to 80 000 km of distance accumulation or equivalent dynamometer operation within the conditions specified in Clause 27A.5 and with the appropriate emission control system installed and operating.

27A.4.3 Emission tests on durability data vehicles shall be conducted at 0 km, immediately before and after major tune-ups provided for in Clause 27A.5.4, and at other points so that no intervals between tests exceeds 8 450 km except that fuel evaporative emission tests are only required to be performed at the 6 400 km and 80 000 km test points. All tests shall be conducted to the requirements of Clause 27A.6 for fuel evaporative emissions and Clause 27A.7 for exhaust emissions.

* Amended July 1983

27A.4.4 All emission test data, except the 0 km test data, derived from the durability data vehicles having the same engine family - control system combination, shall be expressed as a function of the accumulated distance. The best fit straight lines determined by the method of least squares shall be established in respect in respect of exhaust HC, exhaust CO, exhaust NO_x and fuel evaporative HC. Emission levels on those lines shall be established for 80 000 km and 6 400 km and these shall be not greater than the emission levels specified in Clauses 27A.2.1(i) and 27A.2.1(ii).

27A.4.5 Deterioration factors shall be calculated as follows:-

(i) For each nominated exhaust emission product,

$$\text{Factor} = \frac{\text{established exhaust emissions at 80 000 km}}{\text{established exhaust emissions at 6 400 km}}$$

provided that, if the factor so calculated is less than 1, the deterioration factor shall be taken as 1;

(ii) For fuel evaporative emissions,

Factor = established fuel evaporative emissions at 80 000 km minus the established fuel evaporative emissions at 6 400km

provided that, if the factor so calculated is less than 0, the deterioration factor shall be taken as 0.

27A.4.6 Unless otherwise determined by the Administrator, emission data vehicles shall be subjected to 6 400 km of distance accumulation or equivalent dynamometer operation within the conditions specified in Clause 27A.5 and with the appropriate emission control systems installed and operating.

27A.4.7 For emission data vehicles, emission tests shall be conducted at 0 km and 6 400 km to the requirements of Clause 27A.6 for fuel evaporative emissions and Clause 27A.7 for exhaust emissions.

27A.4.8 All fuel evaporative emission test data derived from emission data vehicles at 6 400 km, shall be adjusted by the addition of the appropriate deterioration factor and the resulting levels shall not be greater than the fuel evaporative emission levels referred to in Clause 27A.2.1.

27A.4.9 All exhaust emission test data derived from emission data vehicles, at 6 400 km, shall be multiplied by the appropriate deterioration factor and the resulting levels shall not be greater than the exhaust emission levels referred to in Clause 27A.2.1.

27A.5 DISTANCE ACCUMULATION

27A.5.1 The fuel used in distance accumulation shall be

(a) for unleaded petrol-engined vehicles (refer Definitions Clause 27A.1.19) either unleaded test fuel whose specifications are given in Clause 27A.6.1 and/or Clause 27A.8.1.6 or unleaded petrol (refer Definitions Clause 27A.1.18) representative of commercial unleaded petrol; *

(b) for other vehicles (refer Definitions Clause 27A.1.20) either leaded reference fuel whose specifications are given in Clause 27A.6.1 and/or Clause 27A.8.1.5 or leaded petrol (refer Definitions Clause 27A.1.21) representative of commercial leaded petrol.

27A.5.2 Unless otherwise approved by the Administrator, the distance accumulation or equivalent dynamometer operation of 80 000 km shall be performed in such a manner that:

(i) the number of stops shall be not less than 25 000;

(ii) not more than 20 percent of the distance shall be at speeds in excess of 75 km/h;

(iii) the average travelling speed shall be not greater than 60 km/h;

(iv) not more than 10 percent of the distance shall be at speeds in excess of 90 km/h;

(v) the total idle time shall be not less than 200 hours;

(vi) the pattern of operation shall be designed in such a way that the average conditions determined from the above, could be expected to be experienced in any single hour of operation.

27A.5.3 Unless otherwise approved, engine and fuel system maintenance on emission data vehicles shall be limited to normal scheduled maintenance to the extent and at the intervals recommended by the manufacturer to the ultimate vehicle purchaser as required by Clause 27A.2.4.

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27A.5.4 Unless otherwise approved, scheduled maintenance on the engine, emission control system, and fuel system of durability data vehicles shall be scheduled to be performed during durability testing at the same distance intervals that will be specified in the manufacturer's maintenance instructions as provided in accordance with Clause 27A.2.4. Such maintenance shall be performed only under the following provisions:

(i) Scheduled major engine tune-ups to manufacturer's specifications may be performed no more frequently than every 20 000 km of scheduled driving provided that no tune-up may be performed after 72 000 km of scheduled driving. A scheduled major engine tune-up shall be restricted to (a) to (k) below and shall be conducted in a manner consistent with service instructions and specifications provided by the manufacturer for use by customer service personnel. The following items may be inspected, replaced, cleaned, adjusted, and/or serviced as required;

(a) ignition system,

(b) cold starting enrichment system (includes fast idle speed setting),

(c) kerb idle speed and air/fuel mixture,

(d) drive belt tension on engine accessories,

(e) valve lash,

(f) inlet air and exhaust gas control valves,

(g) engine bolt torque,

(h) spark plugs,

(i) fuel filter and air filter,

(j) crankcase emission control system,

(k) fuel evaporative emission control system;

(ii) Change of engine and transmission oil, and change or service of oil filter will be allowed at the same distance intervals that will be specified in the manufacturer's maintenance instructions;

(iii) Readjustment of the engine idle speed (kerb idle and fast idle) may be performed once during the first 8 000 km of vehicle operation, in addition to during scheduled major engine tune-ups.

27A.5.5 Unless otherwise approved, unscheduled maintenance on the engine, emission control system, and fuel system of durability vehicles may be performed only under the following provisions:

(i) any persistently misfiring spark pulg may be replaced, in addition to replacement at scheduled major engine tune-up points;

(ii) readjustment of the engine cold starting enrichment system may be performed if there is a problem of stalling or if there is visible black smoke;

(iii) readjustment of the engine idle speed (kerb idle and fast idle) may be performed, in addition to that performed as scheduled maintenance under Clause 27A.5.4, if the idle speed exceeds the manufacturer's recommended idle speed by 300 r.p.m. or more, or if there is a problem of stalling;

(iv) the idle mixture may be reset other than during scheduled major engine tune-ups, only with the advanced approval of the Administrator.

27A.5.6 Unless otherwise approved, repairs to vehicle components of the durability or emission data vehicle, other than the engine, emission control system, or fuel system, shall be performed only as a result of part failure or vehicle system malfunction.

27A.6 FUEL EVAPORATIVE EMISSION TEST

27A.6.1 Unless otherwise approved, the fuel used for the determination of fuel evaporative emission levels shall conform to the following specifications:

27A.6.1.1 For unleaded petrol-engined vehicles (refer Definitions Clause 27A.1.19) unless otherwise approved the test fuel used shall be unleaded petrol (refer Definitions Clause 27A.1.18) whose specifications are given in Clause 27A.6.1.3. *

27A.6.1.2 For other vehicles (refer Definitions clause 27A.1.20) unless otherwise approved the test fuel shall be leaded petrol (refer Definitions clause 27A.1.21) whose specifications are given in Clause 27A.6.1.3.

27A.6.1.3 Specifications of fuel evaporative emission test fuel *

PROPERTY	TEST METHOD ASTM	IP	SPECIFICATION
Distillation Range (°C)	D 86		
Initial Boiling Point			24- 35
10 percent point			49- 57
50 percent point			93-110
90 percent point			149-163
End Point			213 maximum
Hydrocarbon Composition	D 1319	156	
Olefins, percent,			10 maximum
Aromatics, percent,			35 maximum
Saturates			Remainder
Reid Vapour Pressure (kPa)	D 323	69	60.0-63.4

27A.6.2 Vehicle and engine preparation for fuel evaporative emission test *

27A.6.2.1 Exhaust emission control systems installed on or incorporated in the test vehicle shall be functioning normally during the fuel evaporative emission test.

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27A.6.2.2 Appropriate leak-proof fittings shall be applied to all fuel system external vents to permit collection of effluent vapours from these vents during the course of the prescribed tests. Since the prescribed test requires the temporary plugging of the inlet pipe to air cleaner, it will be necessary to install a probe for collecting the normal effluents from this source. Where antisurge/vent filler caps are employed on the fuel tank, the normal vent shall be plugged if it does not conveniently lend itself to the collection of vapours which emanate from it, and a separate vent, with appropriate fittings, shall be introduced on the cap. Where the fuel tank vent line terminus is inaccessible, the line shall be severed at a convenient point near the fuel tank and the collection system installed in a closed circuit assembly with the severed ends. All fittings shall terminate for ready connection to the collection systems and shall be designed for minimum dead space. The design and installation of the necessary fittings shall not disturb the normal function of the fuel system components or the normal pressure relationships in the system.

27A.6.2.3 The fuel system shall be free of any leaks to the atmosphere of either liquid or vapour. Any pressure tests undertaken to check the system shall neither purge nor load the fuel evaporative emission control system.

27A.6.2.4 The fuel tank shall be prepared for recording the temperature of the prescribed test fuel at its approximate mid-volume.

27A.6.2.5 Additional fittings and adaptors may be provided to accommodate a fuel drain at the lowest point possible in the tank as installed on the vehicle.

27A.6.3 Vehicle preconditioning for fuel evaporative emission test *

27A.6.3.1 The test vehicle shall be operated under the conditions prescribed for distance accumulation in Clause 27A.5 for one hour immediately prior to the operations prescribed below.

27A.6.3.2 The fuel tank shall be drained and the test fuel specified in Clause 27A.8.1 shall be added. The fuel evaporative emission control system or device shall not be abnormally purged or loaded as a result of draining or fuelling the tank.

27A.6.3.3 The test vehicle shall be placed on the dynamometer and operated over a simulated trip, according to the appropriate requirements and procedures of Clause 27A.8. During the run the ambient temperature shall be between 20°C and 30°C.

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27A.6.3.4 The engine and cooling fan shall be stopped upon completion of the dynamometer operation and the vehicle permitted to soak either on or off the dynamometer stand at an ambient temperature between 24°C and 30°C for a period of not less than one hour prior to the soak period prescribed in Clause 27A.6.4.

27A.6.4 Fuel evaporative emission collection procedure

The following procedure shall be performed in sequence and without any interruption in the conditions prescribed.

27A.6.4.1 Diurnal breathing loss test: The test vehicle shall be allowed to soak in an area where the ambient temperature is maintained between 15°C and 30°C for a period of not less than 10 hours. (The vehicle preparation requirements of Clause 27A.6.2 may be performed during this period). It shall then be transferred to a soak area where the ambient temperature is maintained between 24°C and 30°C. Upon admittance to the 24°C to 30°C soak area, the fuel tank thermocouple shall be connected to the recorder and the fuel and ambient temperature recorded.

27A.6.4.2 The fuel tank shall be drained and recharged with the test fuel as specified in Clause 27A.6.1 to within 4 litres of 40 percent of the nominal fuel tank capacity. The temperature of the fuel following the charge to the tank shall be 15.5°C ± 1°C. The Fuel evaporative emission control system or device shall not be abnormally loaded as a result of fuelling the tank.

27A.6.4.3 Immediately following the fuel charge to the tank, the exhaust pipe(s) and inlet pipe to the air cleaner shall be plugged and vapour collection systems, prescribed in Clause 27A.6.5.1 installed on all fuel system external vents. Multiple vents may be connected to a single collection trap provided that, where there is more than one external vent on a fuel system distinguishing between carburettor and tank vapours, separate collection systems shall be employed to trap the vapours from the separate sources. The collection tubing employed shall be of minimum length and there shall be no sharp bends.

27A.6.4.4 The fuel in the tank shall be heated to 29°C ± 1°C. The prescribed temperature of the fuel shall be achieved over a period of 60 minutes ± 10 minutes with substantially constant rate of temperature rise. After a minimum of one hour, following admittance to the 24°C to 30°C soak area the vehicle shall be moved onto the dynamometer stand for the subsequent part of the test. The fuel tank thermocouple may be temporarily disconnected to permit moving the test vehicle. Plugs shall be removed from the exhaust pipe(s) and inlet pipe to the air cleaner.

27A.6.4.5 Running loss test: The vehicle shall be placed on the dynamometer and the fuel tank thermocouple reconnected. The fuel temperature and the amient air temperature shall be recorded. Where the only external vent(s) is located in the immediate vicinity of the carburettor air horn, such that any 'running loss' emissions would be inducted into the engine, there is no requirement to collect any vapour losses during this part of the test and the vapour loss measurement system shall be temporarily disconnected and clamped.

27A.6.4.6 The vehicle shall be operated on the dynamometer according to the requirements and procedures of Clause 27A.8. The engine and fan shall be turned off upon completion of the dynamometer run and the exhaust and air cleaner inlet pipes shall be replugged. Any vapour collection system employed during this part of the test shall be left intact for continued use during the following part. Any part of the vapour collection system disconnected during this phase of the test shall be reconnected for the following phase.

27A.6.4.7 Hot soak test: Upon completion of the dynamometer run, the test vehicles shall be permitted to soak with hood down for a period of one hour at an ambient temperature between 24°C and 30°C.

27A.6.4.8 The traps shall be disconnected, sealed and weighed. The difference in the total mass of the collection system(s) before and after the tests shall be recorded as the mass of the fuel evaporative emissions for the test.

27A.6.5 Sampling and analytical system for fuel evaporative emission test*

27A.6.5.1 Hydrocarbon losses from the carburettor, fuel system including fuel tank, vent line and filler cap and, where appropriate, the air cleaner, shall be collected in approved activated carbon traps.

27A.6.5.2 The activated carbon employed shall meet the following requirements:

Surface area #	-	1 000 m^2/gram, minimum
Adsorption capacity (carbon tetrachloride)	-	60 percent, by weight, minimum

\# To be determined by the nitrogen method specified by Brunaur Emmett and Teller, Journal of the Americal Chemical Society, Vol. 60, p. 309, 1938.

* Amended July 1983

Volatile material including absorbed water vapour	-	None

Screen analysis size -	Percent
Less than 1.4 mm	0
1.7 to 2.4 mm	90 - 100
More than 3.0mm	0

27A.7 EXHAUST EMISSION TEST

27A.7.1 The test vehicle shall be allowed to stand with engine turned off for a period of not less than 12 hours prior to the test, at an ambient temperature between 15°C and 30°C. The vehicle shall be stored in such a manner that precipitation does not occur on the vehicle. During the run the ambient temperature shall be between 20°C and 30°C.

27A.7.2 The vehicle shall be placed on the dynamometer and operated over a simulated journey according to the appropriate requirements and procedures of Clause 27A.8.

27A.7.3 During the test cycle, the exhaust emissions shall be diluted with air to a constant volume. A portion of the mixture shall be sampled continuously during the entire test cycle from the time cranking is started, and collected in a bag for subsequent analysis. A parallel sample of the dilution air shall also be collected for analysis. The laboratory equipment and procedures shall be approved by the Administrator.

27A.7.4 Within 10 minutes of the conclusion of the test, the concentration of CO, HC and NO_x in the samples, shall be determined by the methods prescribed in Clause 27A.7.5.

27A.7.5 Analytical systems for exhaust emission test *

27A.7.5.1 Hydrocarbons in exhaust emissions shall be determined by using flame ionization detection analysis equipment calibrated with propane using air as a diluent.

27A.7.5.2 Carbon monoxide shall be determined using non dispersive infra-red analysers calibrated with carbon monoxide using nitrogen as a diluent. Multimixes of carbon monoxide and carbon dioxide in nitrogen may be used.

27A.7.5.3 Oxides of nitrogen in exhaust gases shall be determined using chemiluminescent analysis. Not less than 95 percent of the nitrogen dioxide shall be converted to nitric oxide before analysis. The analyser shall be calibrated with nitric oxide using nitrogen as a diluent.

27A.7.5.4 The hydrocarbon analyser shall be zeroed before the commencement of each test with zero-grade air and the carbon monoxide and oxides of nitrogen analysers with either zero-grade air or nitrogen. The allowable zero gas impurity concentrations shall not exceed 6 ppm equivalent carbon response, 10 ppm carbon monoxide and one ppm nitric oxide. For the purposes of this Clause, air may be a blend of nitrogen and oxygen with the oxygen concentration between 18 and 21 percent by volume.

* Amended July 1983

27A.7.5.5 The analysers shall be spanned before and after each test using span gases of concentration approximately 80 percent of full scale readings.

27A.7.6 The test results shall be computed by use of the following formulae:

For Hydrocarbon mass -

$$HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc}}{1\ 000\ 000}$$

For Carbon monoxide mass -

$$CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc}}{100}$$

For Oxides of nitrogen mass -

$$NO_{x_{mass}} = V_{mix} \times Density_{NO_2} \times \frac{NO_{x_{conc}}}{1\ 000\ 000} \times K_H$$

Meaning of Symbols

HC_{mass} = Hydrocarbon emissions, in grams per vehicle kilometre.

$Density_{HC}$ = Density of exhaust hydrocarbons, assuming an average carbon to hydrogen ratio of 1:1.85, in grams per litre at 20°C and 760mm Hg pressure

= 0.577 gram/litre.

HC_{conc} = Hydrocarbon concentration of the dilute exhaust sample minus hydrocarbon concentration of the dilution air sample, in ppm carbon equivalent i.e. equivalent propane x 3.

CO_{mass} = Carbon monoxide emissions, in grams per vehicle kilometre.

$Density_{CO}$ = Density of carbon monoxide in grams per litre at 20°C and 760mm Hg pressure

= 1.164 gram/litre.

CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample minus the carbon monoxide concentration of the dilution air sample, in volume percent.

$NO_{x_{mass}}$ = Oxides of nitrogen emissions, in grams per vehicle kilometre.

$Density_{NO2}$ = Density of exhaust oxides of nitrogen assuming they are in the form of nitrogen dioxide in grams per litre at 20°C and 760mm Hg pressure

= 1.913 gram/litre.

$NO_{x_{conc}}$ = Oxides of nitrogen concentration of the dilute exhaust sample minus the oxides of nitrogen concentration of the dilution air sample, in ppm.

V_{mix} = Total dilute exhaust volume in litres per kilometre corrected to standard conditions (293 degrees Kelvin and 760 mm Hg)

$$= K_1 \times V_o \times N \times \frac{P_B - P_i}{T_P}$$

where:

$$K_1 = \frac{293 \text{ (degrees Kelvin)}}{760 \text{ (mm Hg)} \times 12.07 \text{ (Kilometres)}}$$

= 0.03194

V_o = Volume of gas pumped by the positive displacement pump, in litres per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

N = Number of revolutions of the positive displacement pump during the test while samples are being collected.

P_B = Barometric pressure, in mm Hg.

P_i = Pressure depression below atmosphere measured at the inlet to the positive displacement pump.

T_P = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Kelvin.

K_H = Humidity correction factor

$$K_H = \frac{1}{1-0.0329(H-10.71)}$$

where:

H = Absolute humidity, in grams of water per kilogram of dry air.

$$H = \frac{(6.211)R_a \times Pd}{P_B-(P_d \times R_a/100)}$$

R_a = Relative humidity of the ambient air, in percent.

P_d = Saturated vapour pressure, in mm Hg at the ambient dry bulb temperature.

27A.7.7 When the approved sampling method includes dilution by a means other than a positive displacement pump, equivalent calculating procedures shall be used.

27A.8 DYNAMOMETER TEST CYCLE

27A.8.1 Test fuels

27A.8.1.1 Except in the case of fuel evaporative emission tests and unless otherwise approved, the fuel used during the dynamometer test cycle shall conform to the following specifications:

27A.8.1.2 For unleaded petrol-engined vehicles (refer Definitions clause 27A.1.19) unless otherwise approved the fuel shall be the unleaded test fuel whose specifications are given in Clause 27A.8.1.6. *

27A.8.1.3 For other vehicles (refer Definitions Clause 27A.1.20) unless otherwise approved the fuel shall be the leaded reference fuel whose specifications are given in Clause 27A.8.1.5.

27A.8.1.4 Where the Administrator determines that the vehicles represented by a test vehicle will be operated using fuels of a different lead content or octane rating than that prescribed, he may consent in writing to use of a fuel otherwise substantially equivalent but with a different lead content or octane rating.

* Amended July 1983

27A.8.1.5 Specifications of leaded reference fuel *

PROPERTY	TEST METHOD ASTM	IP	SPECIFICATION
Octane Number, Research	D 1656 or D 2699	237	97 minimum
Lead (organic) as Pb, gram/litre	D 526	96	0.37 "
Phosphorus, gram/litre			0.015 max.
Distillation Range (°C)	D 86	123	
Initial Boiling Point			-
10 percent point			45- 57
50 percent point			90-110
90 percent point			149-163
End Point			213 max.
Hydrocarbon Composition	D 1319	156	
Olefins, percent			22 max.
Aromatics, percent			40 max.
Saturates			Remainder
Reid Vapour Pressure (kPa)	D 323	69	55.2-64.9

27A.8.1.6 Unleaded test fuel specifications

PROPERTY	ASTM TEST METHOD	SPECIFICATION
Octane Number, Research	D 2699	91 minimum, 93 maximum
Octane Number, Motor	D 2700	82 minimum
Lead (organic), gram/litre	D 3237	0.013 maximum
Sulphur, percent by weight	D 1266 or D 2785	0.10 maximum
Phosphorus, gram/litre	D 3231	0.0013 maximum

* Amended July 1983

Unleaded test fuel specifications - cont.

Distillation Range (°C)	D 86	
Initial Boiling Point		24-35
10 percent point		49-57
50 percent point		93-110
90 percent point		149-163 *
End point		213 maximum
Hydrocarbon Composition:	D 1319	
Olefins, percent by volume		10 maximum
Aromatics, percent by volume		35 maximum
Saturates		Remainder
Reid Vapour Pressure (kPa)	D 323 or D 2551	55.0-63.4 (8.0-9.2 psi)

27A.8.2 Dynamometer calibration

27A.8.2.1 The dynamometer shall incorporate a power absorption unit which when compensated for dynamometer friction results in an equivalent road load at 80 km/h within 0.2 kW of the figure indicated in the Table in Clause 27A.8.2.2 for the appropriate mass or otherwise established by test.

27A.8.2.2 The dynamometer shall be loaded to simulate the inertia of the vehicle. For this purpose the vehicle shall be considered to have an equivalent inertia not less than the figure shown in the following Table appropriate for the mass of the vehicle.

Reference Mass kg	Equivalent Inertia kg	Road Load Power kW
Up to 510	454	4.4
511-624	454	4.8
625-737	680	5.3
738-850	794	5.7
851-964	907	6.2
965-1077	1020	6.6
1078-1191	1134	7.0
1192-1304	1247	7.4
1305-1474	1361	7.7
1475-1701	1588	8.4
1702-1928	1814	9.0
1929-2155	2041	9.5
2156-2381	2268	10.0
2382-2608	2495	10.4
2609 and over	2495	10.8

* Amended July 1983

27A.8.3 Dynamometer test procedure

27A.8.3.1 The vehicle shall be at its Reference Mass as defined in Clause 27A.1.15 and all emission control systems installed on or incorporated in the test vehicle shall be functioning during the test.

27A.8.3.2 Engine cooling during the test may be assisted by the provision of a fixed speed fan of capacity not greater than 150 m^3/minute unless it can be established that cooling air in excess of this value is available during normal operations. The fan shall be positioned within 200-310 mm in front of the cooling air inlets except that for rear engine vehicles or other vehicles for which the required fan location would be impractical, the fan may be placed so that sufficient air is provided for engine cooling.

27A.8.3.3 The vehicle shall be operated over the driving cycle prescribed in Clause 27A.9.

27A.8.3.4 The following driving requirements shall be met during the test:

(i) For 3 speed manual transmissions -

(a) Unless otherwise specified the test shall be run in highest gear.

(b) Vehicles equipped with free wheeling or overdrive units shall be tested with this unit (free wheeling or overdrive) locked out of operation.

(c) Idle shall be run with transmission in gear and with clutch disengaged (except first idle; see Clause 27A.8.3.5).

(d) The vehicle shall be driven with minimum throttle movement to maintain the desired speed.

(e) Acceleration modes shall be driven smoothly with the shift speeds as recommended by the manufacturer. Where the manufacturer does not recommend shift speeds, the vehicle shall be shifted from first to second gear at 24 km/h and from second to third gear at 40 km/h. The operator shall release the accelerator pedal during the shift and accomplish the shift with minimum closed throttle time. If the vehicle cannot accelerate at the specified rates, the vehicle shall be accelerated at wide open throttle until the vehicle speed reaches the speed at which it should be at that time during the test.

(f) The deceleration modes shall be run with clutch engaged and without shifting gears from the previous mode, using brakes or throttle as necessary to maintain the desired speed. For those modes which decelerate to zero, the clutch shall be depressed when the speed drops below 24 km/h, when engine roughness is evident, or when engine stalling is imminent.

(g) Downshifting is allowed at the beginning of or during a power mode when recommended by the manufacturer or when the engine obviously is lugging.

(ii) For 4 and 5 speed manual transmissions -

(a) The same procedure as for 3 speed manual transmissions shall be followed for shifting from first to second gear and from second to third gear. Where the manufacturer does not recommend shift speeds, the vehicle shall be shifted from third to fourth gear at 65 km/h. Fifth gear may be used at the manufacturer's option.

(b) Where the transmission ratio in first gear exceeds 5:1, the procedure for 3 or 4 speed manual transmission vehicles shall be followed as if the first gear did not exist.

(iii) For automatic transmissions -

(a) The test shall be run with the transmission in 'Drive' (highest gear). Automatic stick-shift transmission may be shifted as manual transmissions at the option of the manufacturer.

(b) Idle modes shall be run with the transmission in 'Drive' and the wheels braked (except first idle; see Clause 27A.8.3.5).

(c) The vehicle shall be driven with minimum throttle movement to maintain the desired speed.

(d) Acceleration modes shall be driven smoothly allowing the transmission to shift automatically through the normal sequence of gears. If the vehicle cannot accelerate at the specified rates, the vehicle shall be accelerated at wide open throttle until the vehicle speed reaches the speed at which it should be at that time during the driving schedule.

(e) The deceleration modes shall be run in gear using brakes or throttle as necessary to maintain the desired speed.

27A.8.3.5 The following engine starting and restarting requirements shall be met during the test:

(i) The engine shall be started according to the manufacturer's recommended starting procedures. The initial 20 second idle period shall begin when the engine starts.

(ii) Vehicles equipped with automatic chokes shall be operated according to the instructions which will be included in the manufacturer's operating or owner's manual including choke and setting and 'kick-down' from cold fast idle. If choke 'kick-down' time is not specified, it shall be performed 13 seconds after the engine starts. The transmission shall be placed in gear 15 seconds after the engine is started. If necessary, braking may be employed to keep the drive wheels from turning.

(iii) Vehicles equipped with manual chokes shall be operated according to the manufacturer's operating or owner's manual. If not specified, the choke shall be operated to maintain engine idle at 1 100 $\pm$ 50 r.p.m. during the initial idle period and used where necessary during the remainder of the test to keep the engine running.

(iv) The operator may use more choke, more throttle, etc, where necessary to keep the engine running.

(v) If the vehicle does not start after 10 seconds of cranking, the test shall be aborted.

(vi) If the engine stalls during an idle period, the engine shall be restarted immediately and the test continued. If the engine cannot be started soon enough to allow the vehicle to follow the next acceleration as prescribed, the driving schedule indicator shall be stopped. When the vehicle restarts, the driving schedule indicator shall be reactivated.

(vii) If the engine stalls during some operating mode other than idle, the driving schedule indicator shall be stopped, the vehicle restarted, accelerated to the speed required at that point in the driving schedule and the test continued.

(viii) If the vehicle will not restart within one minute, the test shall be voided.

27A.9 DYNAMOMETER DRIVING CYCLE

The following table sets out the equivalent vehicle speeds appropriate at one second intervals of time after the engine starts. The vehicle speed to be achieved at any particular time 't' seconds shall be within 3.3 km/hour of at least one of the speeds indicated for (t-1), t and (t+1). Speed variations outside the prescribed tolerance are permitted provided that their duration is less than 2 seconds. Speeds lower than those prescribed are permitted provided that the vehicle is being operated at maximum available power.

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
0	0.0	45	30.7	90	49.4	135	0.0
1	0.0	46	34.0	91	49.1	136	0.0
2	0.0	47	36.5	92	48.9	137	0.0
3	0.0	48	36.9	93	48.8	138	0.0
4	0.0	49	36.5	94	48.9	139	0.0
5	0.0	50	36.4	95	49.6	140	0.0
6	0.0	51	34.3	96	48.9	141	0.0
7	0.0	52	30.6	97	48.1	142	0.0
8	0.0	53	27.5	98	47.5	143	0.0
9	0.0	54	25.4	99	48.0	144	0.0
10	0.0	55	25.4	100	48.8	145	0.0
11	0.0	56	28.5	101	49.4	146	0.0
12	0.0	57	31.9	102	49.7	147	0.0
13	0.0	58	34.8	103	49.9	148	0.0
14	0.0	59	37.3	104	49.7	149	0.0
15	0.0	60	38.9	105	48.9	150	0.0
16	0.0	61	39.6	106	48.0	151	0.0
17	0.0	62	40.1	107	48.1	152	0.0
18	0.0	63	40.2	108	48.6	153	0.0
19	0.0	64	39.6	109	49.4	154	0.0
20	0.0	65	39.4	110	50.2	155	0.0
21	4.8	66	39.8	111	51.2	156	0.0
22	9.5	67	39.9	112	51.8	157	0.0
23	13.8	68	39.8	113	52.1	158	0.0
24	18.5	69	39.6	114	51.8	159	0.0
25	23.0	70	39.6	115	51.0	160	0.0
26	27.2	71	40.4	116	46.0	161	0.0
27	27.8	72	41.2	117	40.7	162	0.0
28	29.1	73	41.4	118	35.4	163	0.0
29	33.3	74	40.9	119	30.1	164	5.3
30	34.9	75	40.1	120	24.8	165	10.6
31	36.0	76	40.2	121	19.5	166	15.9
32	36.2	77	40.9	122	14.2	167	21.2
33	35.6	78	41.8	123	8.9	168	26.6
34	34.6	79	41.8	124	3.5	169	31.9
35	33.6	80	41.4	125	0.0	170	35.7
36	32.8	81	42.0	126	0.0	171	39.1
37	31.9	82	43.0	127	0.0	172	41.5
38	27.4	83	44.3	128	0.0	173	42.5
39	24.0	84	46.0	129	0.0	174	41.4
40	24.0	85	47.2	130	0.0	175	40.4
41	24.5	86	48.0	131	0.0	176	39.8
42	24.9	87	48.4	132	0.0	177	40.2
43	25.7	88	48.9	133	0.0	178	40.6
44	27.5	89	49.4	134	0.0	179	40.9

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
180	41.5	225	85.6	270	82.9	315	50.7
181	43.8	226	87.1	271	83.0	316	49.2
182	42.6	227	87.9	272	83.4	317	49.1
183	38.6	228	88.4	273	83.8	318	48.3
184	36.5	229	88.5	274	84.5	319	46.7
185	31.2	230	88.4	275	85.3	320	44.3
186	28.5	231	87.9	276	86.1	321	39.9
187	27.7	232	87.9	277	86.9	322	34.6
188	29.1	233	88.2	278	88.4	323	32.3
189	29.9	234	88.7	279	89.2	324	30.7
190	32.2	235	89.3	280	89.5	325	29.8
191	35.7	236	89.6	281	90.1	326	27.4
192	39.4	237	90.3	282	90.1	327	24.9
193	43.9	238	90.6	283	89.8	328	20.1
194	49.1	239	91.1	284	88.8	329	17.4
195	53.9	240	91.2	285	87.7	330	12.9
196	58.3	241	91.2	286	86.3	331	7.6
197	60.0	242	90.9	287	84.5	332	2.3
198	63.2	243	90.9	288	82.9	333	0.0
199	65.2	244	90.9	289	82.9	334	0.0
200	67.8	245	90.9	290	82.9	335	0.0
201	70.0	246	90.9	291	82.2	336	0.0
202	72.6	247	90.9	292	80.6	337	0.0
203	74.0	248	90.8	293	80.5	338	0.0
204	75.3	249	90.3	294	80.6	339	0.0
205	76.4	250	89.8	295	80.5	340	0.0
206	76.4	251	88.7	296	79.8	341	0.0
207	76.1	252	87.9	297	79.7	342	0.0
208	76.0	253	87.2	298	79.7	343	0.0
209	75.6	254	86.9	299	79.7	344	0.0
210	75.6	255	86.4	300	79.0	345	0.0
211	75.6	256	86.3	301	78.2	346	0.0
212	75.6	257	86.7	302	77.4	347	1.6
213	75.6	258	86.9	303	76.0	348	6.9
214	76.0	259	87.1	304	74.2	349	12.2
215	76.3	260	87.1	305	72.4	350	17.5
216	77.1	261	86.6	306	70.5	351	22.9
217	78.1	262	85.9	307	68.6	352	27.8
218	79.0	263	85.3	308	66.8	353	32.2
219	79.7	264	84.7	309	64.9	354	36.2
220	80.5	265	83.8	310	62.0	355	38.1
221	81.4	266	84.3	311	59.5	356	40.6
222	82.1	267	83.7	312	56.6	357	42.8
223	82.9	268	83.5	313	54.5	358	45.2
224	84.0	269	83.2	314	52.3	359	48.3

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
360	49.6	405	14.8	450	15.9	495	45.1
361	50.9	406	20.1	451	21.2	496	41.0
362	51.7	407	25.4	452	26.6	497	36.2
363	52.3	408	30.7	453	31.9	498	31.9
364	54.1	409	36.0	454	37.2	499	26.6
365	55.5	410	40.2	455	42.5	500	21.2
366	55.7	411	41.2	456	44.7	501	16.6
367	56.2	412	44.3	457	46.8	502	11.6
368	56.0	413	46.7	458	50.7	503	6.4
369	55.5	414	48.3	459	53.1	504	1.6
370	55.8	415	48.4	460	54.1	505	0.0
371	57.1	416	48.3	461	56.0	506	0.0
372	57.9	417	47.8	462	56.5	507	0.0
373	57.9	418	47.2	463	57.3	508	0.0
374	57.9	419	46.3	464	58.1	509	0.0
375	57.9	420	45.1	465	57.9	510	0.0
376	57.9	421	40.2	466	58.1	511	1.9
377	57.9	422	34.9	467	58.3	512	5.6
378	58.1	423	29.6	468	57.9	513	8.9
379	58.6	424	24.3	469	57.5	514	10.5
380	58.7	425	19.0	470	57.9	515	13.7
381	58.6	426	13.7	471	57.9	516	15.4
382	57.9	427	8.4	472	57.3	517	16.9
383	56.5	428	3.1	473	57.1	518	19.2
384	54.9	429	0.0	474	57.0	519	22.5
385	53.9	430	0.0	475	56.6	520	25.7
386	50.5	431	0.0	476	56.6	521	28.5
387	46.7	432	0.0	477	56.6	522	30.6
388	41.4	433	0.0	478	56.6	523	32.3
389	37.0	434	0.0	479	56.6	524	33.8
390	32.7	435	0.0	480	56.6	525	35.4
391	28.2	436	0.0	481	56.3	526	37.0
392	23.3	437	0.0	482	56.5	527	38.3
393	19.3	438	0.0	483	56.6	528	39.4
394	14.0	439	0.0	484	57.1	529	40.1
395	8.7	440	0.0	485	56.6	530	40.2
396	3.4	441	0.0	486	56.3	531	40.2
397	0.0	442	0.0	487	56.3	532	40.2
398	0.0	443	0.0	488	56.3	533	40.2
399	0.0	444	0.0	489	56.0	534	40.2
400	0.0	445	0.0	490	55.7	535	40.2
401	0.0	446	0.0	491	55.5	536	41.2
402	0.0	447	0.0	492	53.9	537	41.5
403	4.2	448	5.3	493	51.5	538	41.8
404	9.5	449	10.6	494	48.4	539	41.2

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
540	40.6	585	27.4	630	0.0	675	18.7
541	40.2	586	27.5	631	0.0	676	14.0
542	40.2	587	27.4	632	0.0	677	9.3
543	40.2	588	26.7	633	0.0	678	5.6
544	39.3	589	26.6	634	0.0	679	3.2
545	37.2	590	26.6	635	0.0	680	0.0
546	31.9	591	26.7	636	0.0	681	0.0
547	26.6	592	27.4	637	0.0	682	0.0
548	21.2	593	28.3	638	0.0	683	0.0
549	15.9	594	29.8	639	0.0	684	0.0
550	10.6	595	30.9	640	0.0	685	0.0
551	5.3	596	32.5	641	0.0	686	0.0
552	0.0	597	33.8	642	0.0	687	0.0
553	0.0	598	34.0	643	0.0	688	0.0
554	0.0	599	34.1	644	0.0	689	0.0
555	0.0	600	34.8	645	0.0	690	0.0
556	0.0	601	35.4	646	3.2	691	0.0
557	0.0	602	36.0	647	7.2	692	0.0
558	0.0	603	36.2	648	12.6	693	0.0
559	0.0	604	36.2	649	16.4	694	2.3
560	0.0	605	36.2	650	20.1	695	5.3
561	0.0	606	36.5	651	22.5	696	7.1
562	0.0	607	38.1	652	24.6	697	10.5
563	0.0	608	40.4	653	28.2	698	14.8
564	0.0	609	41.8	654	31.5	699	18.2
565	0.0	610	42.6	655	33.8	700	21.7
566	0.0	611	43.5	656	35.7	701	23.5
567	0.0	612	42.0	657	37.5	702	26.4
568	0.0	613	36.7	658	39.4	703	26.9
569	5.3	614	31.4	659	40.7	704	26.6
570	10.6	615	26.1	660	41.2	705	26.6
571	15.9	616	20.8	661	41.8	706	29.3
572	20.9	617	15.4	662	42.0	707	30.9
573	23.5	618	10.1	663	42.2	708	32.3
574	25.7	619	4.8	664	42.3	709	34.6
575	27.4	620	0.0	665	42.5	710	36.2
576	27.4	621	0.0	666	42.6	711	36.2
577	27.4	622	0.0	667	42.6	712	35.6
578	28.2	623	0.0	668	41.8	713	36.5
579	28.5	624	0.0	669	41.0	714	37.5
580	28.5	625	0.0	670	38.0	715	37.8
581	28.2	626	0.0	671	34.4	716	36.2
582	27.4	627	0.0	672	29.8	717	34.8
583	27.2	628	0.0	673	26.4	718	33.0
584	26.7	629	0.0	674	23.3	719	29.0

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
720	24.1	765	0.8	810	55.0	855	43.8
721	19.3	766	0.0	811	54.7	856	44.7
722	14.5	767	4.8	812	54.7	857	45.2
723	10.0	768	10.1	813	54.6	858	46.3
724	7.2	769	15.4	814	54.1	859	46.5
725	4.8	770	20.8	815	53.3	860	46.7
726	3.4	771	25.4	816	53.1	861	46.8
727	0.8	772	28.2	817	52.3	862	46.7
728	0.8	773	29.6	818	51.5	863	45.2
729	5.1	774	31.4	819	51.3	864	44.3
730	10.5	775	33.3	820	50.9	865	43.5
731	15.4	776	35.4	821	50.7	866	41.6
732	20.1	777	37.3	822	49.2	867	40.2
733	22.5	778	40.2	823	48.3	868	39.4
734	25.7	779	42.6	824	48.1	869	39.9
735	29.0	780	44.3	825	48.1	870	40.4
736	31.5	781	45.1	826	48.1	871	41.0
737	34.6	782	45.5	827	48.1	872	41.4
738	37.2	783	46.5	828	47.6	873	42.2
739	39.4	784	46.5	829	47.5	874	43.3
740	41.0	785	46.5	830	47.5	875	44.3
741	42.6	786	46.3	831	47.2	876	44.7
742	43.6	787	45.6	832	46.5	877	45.7
743	44.4	788	45.5	833	45.4	878	46.7
744	44.9	789	45.5	834	44.6	879	47.0
745	45.5	790	45.5	835	43.5	880	46.8
746	46.0	791	45.4	836	41.0	881	46.7
747	46.0	792	44.4	837	38.1	882	46.5
748	45.5	793	44.3	838	35.4	883	45.9
749	45.4	794	44.3	839	33.0	884	45.2
750	45.1	795	44.3	840	30.9	885	45.1
751	44.3	796	44.3	841	30.9	886	45.1
752	43.1	797	44.3	842	32.3	887	44.4
753	41.0	798	44.3	843	33.6	888	43.8
754	37.8	799	44.4	844	34.4	889	42.8
755	34.6	800	45.1	845	35.4	890	43.5
756	30.6	801	45.9	846	36.4	891	44.3
757	26.6	802	48.3	847	37.3	892	44.7
758	24.0	803	49.9	848	38.6	893	45.1
759	20.1	804	51.5	849	40.2	894	44.7
760	15.1	805	53.1	850	41.8	895	45.1
761	10.0	806	53.1	851	42.8	896	45.1
762	4.8	807	54.1	852	42.8	897	45.1
763	2.4	808	54.7	853	43.1	898	44.6
764	2.4	809	55.2	854	43.5	899	44.1

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
900	43.3	945	40.4	990	34.6	1035	0.0
901	42.8	946	41.2	991	35.1	1036	0.0
902	42.6	947	40.4	992	36.2	1037	0.0
903	42.6	948	38.6	993	37.0	1038	0.0
904	42.6	949	35.4	994	36.7	1039	0.0
905	42.3	950	32.3	995	36.7	1040	0.0
906	42.2	951	27.2	996	37.0	1041	0.0
907	42.2	952	21.9	997	36.5	1042	0.0
908	41.7	953	16.6	998	36.5	1043	0.0
909	41.2	954	11.3	999	36.5	1044	0.0
910	41.2	955	6.0	1000	37.8	1045	0.0
911	41.7	956	0.6	1001	38.6	1046	0.0
912	41.5	957	0.0	1002	39.6	1047	0.0
913	41.0	958	0.0	1003	39.9	1048	0.0
914	39.6	959	0.0	1004	40.4	1049	0.0
915	37.8	960	3.2	1005	41.0	1050	0.0
916	35.7	961	8.5	1006	41.2	1051	0.0
917	34.8	962	13.8	1007	41.0	1052	0.0
918	34.8	963	19.2	1008	40.2	1053	1.9
919	34.9	964	24.5	1009	38.8	1054	6.4
920	36.4	965	28.2	1010	38.1	1055	11.7
921	37.7	966	29.9	1011	37.3	1056	17.1
922	38.6	967	32.2	1012	36.9	1057	22.4
923	38.9	968	34.0	1013	36.2	1058	27.4
924	39.3	969	35.4	1014	35.4	1059	29.8
925	40.1	970	37.0	1015	34.8	1060	32.2
926	40.4	971	39.4	1016	33.0	1061	35.1
927	40.6	972	42.3	1017	28.2	1062	37.0
928	40.7	973	44.3	1018	22.9	1063	38.6
929	41.0	974	45.2	1019	17.5	1064	39.9
930	40.6	975	45.7	1020	12.2	1065	41.2
931	40.2	976	45.9	1021	6.9	1066	42.6
932	40.2	977	45.9	1022	1.6	1067	43.1
933	40.2	978	45.9	1023	0.0	1068	44.1
934	39.8	979	44.6	1024	0.0	1069	44.9
935	39.4	980	44.3	1025	0.0	1070	45.5
936	39.1	981	43.8	1026	0.0	1071	45.1
937	39.1	982	43.1	1027	0.0	1072	44.3
938	39.4	983	42.6	1028	0.0	1073	43.5
939	40.2	984	41.8	1029	0.0	1074	43.5
940	40.2	985	41.4	1030	0.0	1075	42.3
941	39.6	986	40.6	1031	0.0	1076	39.4
942	39.6	987	38.6	1032	0.0	1077	36.2
943	38.8	988	35.4	1033	0.0	1078	34.6
944	39.4	989	34.6	1034	0.0	1079	33.2

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
1080	29.0	1125	40.2	1170	8.7	1215	34.6
1081	24.1	1126	40.9	1171	14.0	1216	35.1
1082	19.8	1127	41.5	1172	19.3	1217	35.1
1083	17.9	1128	41.8	1173	24.6	1218	34.6
1084	17.1	1129	42.5	1174	29.9	1219	34.1
1085	16.1	1130	42.8	1175	34.0	1220	34.6
1086	15.3	1131	43.3	1176	37.0	1221	35.1
1087	14.6	1132	43.5	1177	37.8	1222	35.4
1088	14.0	1133	43.5	1178	37.0	1223	35.2
1089	13.8	1134	43.5	1179	36.2	1224	34.9
1090	14.2	1135	43.3	1180	32.2	1225	34.6
1091	14.5	1136	43.1	1181	26.9	1226	34.6
1092	14.0	1137	43.1	1182	21.6	1227	34.4
1093	13.8	1138	42.6	1183	16.3	1228	32.3
1094	12.9	1139	42.5	1184	10.9	1229	31.4
1095	11.3	1140	41.8	1185	5.6	1230	30.9
1096	8.0	1141	41.0	1186	0.3	1231	31.5
1097	6.8	1142	39.6	1187	0.0	1232	31.9
1098	4.2	1143	37.8	1188	0.0	1233	32.2
1099	1.6	1144	34.6	1189	0.0	1234	31.4
1100	0.0	1145	32.2	1190	0.0	1235	28.2
1101	0.2	1146	28.2	1191	0.0	1236	24.9
1102	1.0	1147	25.7	1192	0.0	1237	20.9
1103	2.6	1148	22.5	1193	0.0	1238	16.1
1104	5.8	1149	17.2	1194	0.0	1239	12.9
1105	11.1	1150	11.9	1195	0.0	1240	9.7
1106	16.1	1151	6.6	1196	0.0	1241	6.4
1107	20.6	1152	1.3	1197	0.3	1242	4.0
1108	22.5	1153	0.0	1198	2.4	1243	1.1
1109	23.3	1154	0.0	1199	5.6	1244	0.0
1110	25.7	1155	0.0	1200	10.5	1245	0.0
1111	29.1	1156	0.0	1201	15.8	1246	0.0
1112	32.2	1157	0.0	1202	19.3	1247	0.0
1113	33.8	1158	0.0	1203	20.8	1248	0.0
1114	34.1	1159	0.0	1204	20.9	1249	0.0
1115	34.3	1160	0.0	1205	20.3	1250	0.0
1116	34.4	1161	0.0	1206	20.6	1251	0.0
1117	34.9	1162	0.0	1207	21.1	1252	1.6
1118	36.2	1163	0.0	1208	21.1	1253	1.6
1119	37.0	1164	0.0	1209	22.5	1254	1.6
1120	38.3	1165	0.0	1210	24.9	1255	1.6
1121	39.4	1166	0.0	1211	27.4	1256	1.6
1122	40.2	1167	0.0	1212	29.9	1257	2.6
1123	40.1	1168	0.0	1213	31.7	1258	4.8
1124	39.9	1169	3.4	1214	33.8	1259	6.4

Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)	Time (secs)	Speed (km/h)
1260	8.0	1293	40.9	1326	0.0	1359	28.2
1261	10.1	1294	41.2	1327	0.0	1360	26.6
1262	12.9	1295	41.4	1328	0.0	1361	24.9
1263	16.1	1296	41.8	1329	0.0	1362	22.5
1264	16.9	1297	42.2	1330	0.0	1363	17.7
1265	15.3	1298	43.5	1331	0.0	1364	12.9
1266	13.7	1299	44.7	1332	0.0	1365	8.4
1267	12.2	1300	45.5	1333	0.0	1366	4.0
1268	14.2	1301	46.7	1334	0.0	1367	0.0
1269	17.7	1302	46.8	1335	0.0	1368	0.0
1270	22.5	1303	46.7	1336	0.0	1369	0.0
1271	27.4	1304	45.1	1337	0.0	1370	0.0
1272	31.4	1305	39.8	1338	2.4	1371	0.0
1273	33.8	1306	34.4	1339	7.7	1372	0.0
1274	35.1	1307	29.1	1340	13.0		
1275	35.7	1308	23.8	1341	18.3		
1276	37.0	1309	18.5	1342	21.2		
1277	38.0	1310	13.2	1343	24.3		
1278	38.8	1311	7.9	1344	27.0		
1279	39.4	1312	2.6	1345	29.5		
1280	39.4	1313	0.0	1346	31.4		
1281	38.6	1314	0.0	1347	32.7		
1282	37.8	1315	0.0	1348	34.3		
1283	37.8	1316	0.0	1349	35.2		
1284	37.8	1317	0.0	1350	35.6		
1285	37.8	1318	0.0	1351	36.0		
1286	37.8	1319	0.0	1352	35.4		
1287	37.8	1320	0.0	1353	34.8		
1288	38.6	1321	0.0	1354	34.0		
1289	38.8	1322	0.0	1355	33.0		
1290	39.4	1323	0.0	1356	32.2		
1291	39.8	1324	0.0	1357	31.5		
1292	40.2	1325	0.0	1358	29.8		

APPENDIX I

PETROL NOZZLE CHARACTERISTICS

(This Appendix is to be read in conjunction with Clause - 27A.2.6 - Requirements for petrol filler inlet.)

Filler pipes and openings of motor vehicle fuel tanks may be as described in Society of Automative Engineers, Incorporated "Recommended Practice" J1140, entitled "Filler Pipes and Openings of Fule Tanks", to accommodate petrol dispenser nozzle spouts as described in Society of automative Engineers, Incorporated "Recommended Practice" J285a entitled "Gasoline Dispenser Nozzle Spouts".

Leaded Petrol Nozzle - a nozzle used for demonstrating compliance with Clause 27A.2.6 having a spout with an external diameter of 23.6 mm or more. *

This leaded petrol nozzle shall have an automatic shutoff vacuum port, the centre of which shall be located within 22.1 mm of the tip of the terminal end.

This leaded petrol nozzle shall pass less than 120 ml of petrol when fully and rapidly activated with the automatic shutoff vacuum port plugged.

Unleaded Petrol Nozzle - a nozzle having:

(i) a spout with an external diameter of 21.34 mm or less

(ii) the terminal end of the spout shall have a straight section of at least 63 mm in length

(iii) any retaining spring fitted to the nozzle shall terminate 76 mm from the terminal end.

*Amended July 1983

