



COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DESIGN RULE 30
FOR
DIESEL ENGINE EXHAUST SMOKE EMISSIONS

As Endorsed by the
 Australian Transport Advisory Council

The intention of this Australian Design Rule is to limit the opacity of diesel engine exhaust smoke emissions.

The Australian Transport Advisory Council has recommended to Commonwealth, State and Territory Governments that all diesel fuelled motor vehicles specified below shall comply with Australian Design Rule 30 - Diesel Engine Exhaust Smoke Emissions.

VEHICLE CATEGORY	RULE AMENDMENT		
	MANUFACTURED ON OR AFTER		
	30		
Passenger Cars			
Forward Control Passenger Vehicles up to 8 seats	1 Jan 1985		
9 seats	1 Jan 1985		
Other Passenger Cars	1 July 1976		
Passenger Car Derivatives	1 July 1976		
Multi-Purpose Passenger Cars	1 July 1976		
Omnibuses up to 3.5 tonnes GVM			
up to 12 seats	1 July 1976		
over 12 seats	1 July 1976		
up to 4.5 tonnes GVM	1 July 1976		
over 4.5 tonnes GVM	1 July 1976		
Motorcycles	1 July 1976		
Mopeds	1 July 1976		
Specially Constructed Vehicles	N/A		
Other Vehicles not listed above			
up to 4.5 tonnes GVM	1 July 1976		
over 4.5 tonnes GVM	1 July 1976		

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

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 AUSTRALIA

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 AUSTRALIAN DESIGN RULE NO. 30 - DIESEL ENGINE EXHAUST SMOKE EMISSIONS

30.1 Definitions

30.1.1 'Engine System' - A system consisting of the engine together with all devices essential for its operation plus its appropriate intake and exhaust assemblies. Equipment other than superchargers which use engine power for its operation is not part of the engine system.

30.1.2 'Diesel Engine' - An engine which operates on the compression-ignition principle, in this Design Rule referred to as 'the engine'.

30.1.3 'Cold-starting Device' - A device which when activated increases the amount of fuel (excluding special starting fuels) supplied to the engine and is intended to facilitate starting of the engine.

30.1.4 'Opacimeter' - An instrument designed for continuous measurement of the light absorption coefficients of the exhaust gases emitted by engine systems.

30.1.5 'Smoke Meter' - An instrument which determines the smoke density in exhaust gases emitted by engine systems.

30.1.6 'Light Absorption Coefficient' - The coefficient (k) as calculated by the formula $\phi = \phi_0 \cdot e^{-kL}$, where L is the effective length of the light path through the gas to be measured for a given opacimeter, ϕ_0 is the incident flux and ϕ is the emergent flux.

30.1.7 'Full Load' - The condition at which the engine, as specified for certification, in accordance with Clause 30.3.1.3 produces the maximum power possible at a given speed.

30.1.8 'Supercharger' - A device which increases the pressure of the engine intake air it passes into the engine and includes turbochargers.

30.2 Requirements30.2.1 Cold-starting Devices

30.2.1.1 Any cold starting device shall be designed so that it cannot be brought into or retained in operation when the engine is running normally.

30.2.1.2 The provisions of Clause 30.2.1.1 above shall not apply if at least one of the following conditions is met:

- (i) the light absorption coefficient of the exhaust gases emitted by the engine at steady speeds when measured by the procedure prescribed in Clauses 30.3 and 30.4 and with the cold-starting device operating, is within the limits prescribed in Table 1;
- (ii) continued use of the cold-starting device causes the engine to stop.

30.2.2 Exhaust Gas Opacity Limits

30.2.2.1 Except as permitted under Clause 30.2.2.2., each motor vehicle shall be propelled by an engine which, when tested according to the method described in Clauses 30.3 and 30.4, emits exhaust gases with a light absorption coefficient not exceeding the limits prescribed in Table 1.

30.2.2.2 Notwithstanding the requirements of Clause 30.2.2.1 a motor vehicle may

- (i) be propelled by an engine which is approved by the Environmental Protection Agency (USA) with regard to Federal Regulations Part 85 - Control of Air Pollution, for 1974, 1975 or 1976 model year engines, or to Federal Regulations Part 86 - Control of Air Pollution, for 1977 or later model year engines, provided that the engine was tested with fuel recognised in the Federal Regulations as Type 2-D, or
- (ii) be propelled by an engine which is covered by a type test certificate in accordance with the British Standard Specifications for the Performance of Diesel Engines for Road Vehicles, BS AU 141a:1971, or
- (iii) be propelled by an engine which is covered by a type test certificate in accordance with E.C.E. Regulation 24.

30.2.3 Every engine shall have affixed to it a durable legible label of the type described in Clause 30.2.3.1. The label shall indicate that the engine was manufactured to comply with ADR 30 and show the month and year of its manufacture.

30.2.3.1 The label shall be plastic or metal and shall be bonded, welded, rivetted or otherwise securely attached to a part of the engine necessary for normal engine operation and not normally requiring replacement during life and in a position in which it can be read after installation in the vehicle.

30.2.3.2 A label approved by the Environmental Protection Agency (U.S.A.) and attached in accordance with Emission Regulations for New Diesel Fuelled Heavy Duty Engines, shall be deemed to satisfy the labelling requirements of this Design Rule, provided it contains the information required in clause 30.2.3.

30.2.4 The engine, as installed in the vehicle, shall be adjusted to the manufacturer's specifications and these specifications shall be consistent with the settings used during compliance testing.

30.3 Pre-Test Conditions

30.3.1 Engine System

30.3.1.1 The test may be carried out either on a complete vehicle or on a vehicle engine system. In the latter case the engine system may be fitted with an alternative exhaust system provided that it produces a back-pressure not less than that of the standard vehicle exhaust system.

30.3.1.2 The vehicle shall have been run in for not less than 240 kilometres or the engine system for not less than five (5) hours.

30.3.1.3 The engine shall be adjusted to the vehicle manufacturer's specifications.

30.3.1.4 Any orifice which would permit air to be drawn into the exhaust system shall be blocked.

* Amended July 1987

30.3.1.5 The engine system shall be within the normal operating temperature ranges of water, oil and fuel prescribed by the vehicle manufacturer.

30.3.1.6 The absolute temperature T of the inlet air, measured within $150 \text{ mm} \pm 10 \text{ mm}$ of the point of entry to the engine system, expressed in Kelvin, and the atmospheric pressure H , expressed in kPa, shall be measured, and the factor F shall be determined by the formula:

$$\left(\frac{100}{H}\right)^{0.65} \times \left(\frac{T}{298}\right)^{0.5}$$

30.3.1.7 For a test to be recognised as valid, the factor F shall be such that $0.98 \leq F \leq 1.02$.

30.3.2 Fuel and Lubricants

30.3.2.1 The test fuel shall be as specified in Appendix 1 or Appendix 2. |*

30.3.2.2 The lubricants shall be of the type recommended by the vehicle manufacturer for normal service and no additional additives shall be used.

30.3.3 Smoke Sampling and/or Measuring Apparatus

30.3.3.1 The opacimeter, any ancillary instrument and their installation, shall be in accordance with the requirements of Regulation 24, August 1971 annexed to the 1958 United Nations Agreement on Uniform Provisions Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts.

30.3.3.2 Notwithstanding the requirements of Clause 30.3.3.1 the following instruments may be used provided that the procedure is in accordance with the instrument manufacturer's recommendations:

- (i) Hartridge Mark II or Mark III Smokemeters;
- (ii) Robert Bosch Smokemeter (with sampling pump EFAW65A and evaluating instrument EFAW68A);
- (iii) United States Public Health Service Smokemeter;
- (iv) other approved instrument.

30.3.3.3 For the purpose of this Rule, conversion of results from other scales to light absorption coefficients (m^{-1}) shall be made in accordance with Appendix 3. Interpolation is permitted. |*

30.4 Measurement of Light Absorption Coefficients

30.4.1 Test at Full Load and Steady Speeds

30.4.1.1 The smoke density of the exhaust gases produced by the vehicle or engine system shall be measured with the engine running at full load and at steady speed. Measurements shall be taken at four (4) speeds as follows:

★ Amended February 1980

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- (i) At the engine speed corresponding with maximum power:
 - (ii) At engine speeds representing increments of 2/5, 3/5 and 4/5 of the range from the engine speed which is 45% of that for maximum power or 1000 rpm whichever is the higher, to the engine speed corresponding with maximum power.

30.4.1.2 For engines fitted with a supercharger which may be engaged by the driver, measurements shall be made both with and without the supercharger in operation.

30.4.1.3 For each of the four engine speeds at which the absorption coefficient is measured in accordance with Clause 30.4.1.1 above, the nominal gas flow G shall be calculated from the following formula:

(i) For two-cycle engines $G = \frac{Vn}{60}$

(ii) For four-cycle engines $G = \frac{Vn}{120}$

where: G is the nominal gas flow (litres/second)
V is the total engine swept volume (litres)
n is the engine speed (revolutions per minute).

TABLE 1

EXHAUST GAS LIGHT ABSORPTION COEFFICIENT LIMIT VALUES

<u>Nominal Gas Flow G</u> Litres/second	<u>Light Absorption Coefficient</u> -1 m
≤ 42	2.26
45	2.19
50	2.08
55	1.985
60	1.90
65	1.84
70	1.775
75	1.72
80	1.665
85	1.62
90	1.575
95	1.535
100	1.495
105	1.465
110	1.425
115	1.395
120	1.37
125	1.345
130	1.32
135	1.30
140	1.27
145	1.25
150	1.225
155	1.205
160	1.19
165	1.17
170	1.155
175	1.14
180	1.125
185	1.11
190	1.095
195	1.08
≥ 200	1.065

NOTE: Where the nominal gas flow is not one of those tabulated, the appropriate light absorption coefficient shall be determined by applying the principle of interpolation by proportional parts.

APPENDIX 1

SPECIFICATIONS OF TEST FUEL

	<u>Limits and Units</u>	<u>Method</u>
Density 15/4°C	0.830 ± 0.005	ASTM ¹ D 1298-67
Distillation		ASTM D 86-67
50%	min. 245°C	
90%	330 ± 10°C	
Final boiling point	max. 370°C	
Cetane index	54 ± 3	ASTM D 976-66
Kinematic viscosity at 100°F	3 ± 0.5 cst	ASTM D 445-65
Sulphur content	0.4 ± 0.1% by weight	ASTM D 129-64
Flash-point	min. 55°C	ASTM D 99-66
Aniline point	69 ± 5°C	ASTM D 611-64
Carbon residue on 10% bottoms	max. 0.2% by weight	ASTM D524-64
Ash	max. 0.01% by weight	ASTM D 482-63
Water content	max. 0.05% by weight	ASTM D 95-62
Copper - corrosion test at 100°C	max. 1	ASTM D 130-68
Strong acid number	nil mg KOH/g	ASTM D 974-64

Note: The fuel must be based only on straight-run distillates, hydrodesulphurized or not, and must contain no additives.

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APPENDIX 2SPECIFICATIONS OF ALTERNATIVE TEST FUEL

	<u>Limits</u>	<u>Method</u>
Cetane	42-50	ASTM ¹ D613
Distillation range		ASTM D86
IBP °C	170-205	
10% pt. °C	205-240	
50% pt. °C	240-285	
90% pt. °C	285-320	
E.P. °C	305-350	
Gravity °API	33-37	ASTM D287
Total sulphur %	0.2-0.5	ASTM D129 or D2622
Hydrocarbon composition		ASTM D1139
Aromatics %	27 (Min)	
Paraffins, Napthenes, Olefins	Remainder	
Flash point °C (Min)	55	ASTM D93
Viscosity, centistokes	2.0-3.2	ASTM D445

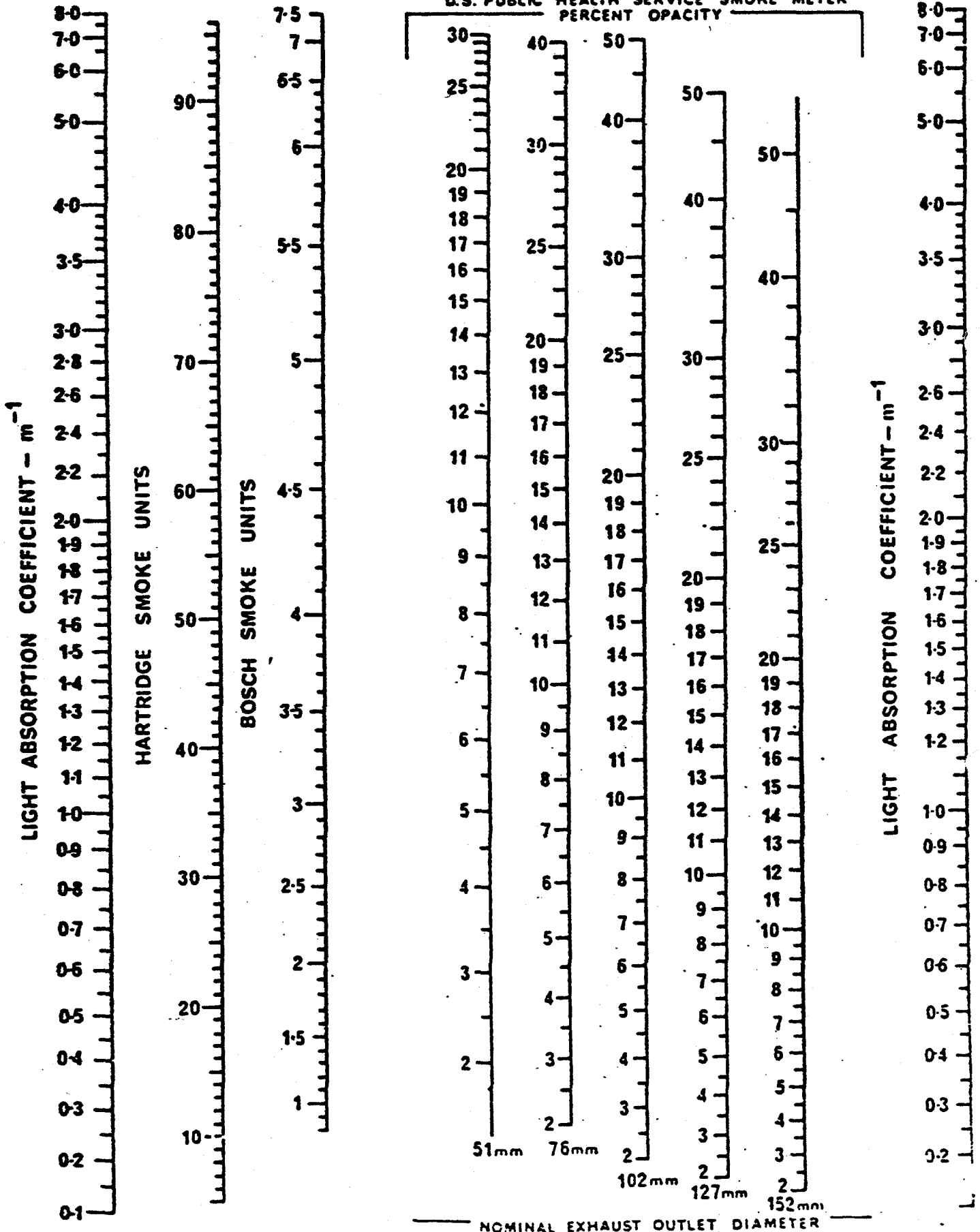
Note: The fuel employed shall be clean and bright, with pour and cloud points adequate for operability. The fuel may contain nonmetallic additives as follows: cetane improver, metal deactivator, antioxidant, dehazer, antirust, pour depressant, dye, and dispersant.

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* Amended February 1980

APPENDIX 3
SMOKE METER CONVERSION CHART

U.S. PUBLIC HEALTH SERVICE SMOKE METER
PERCENT OPACITY



NOMINAL EXHAUST OUTLET DIAMETER

* Amended February 1980