UN Regulation No.83-05

◆Type I Test
（Verifying exhaust emissions after a cold start）

The 58th Asia Expert Meeting in Indonesia
Date: August 26th – 27th , 2019

JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

Explanation of the UNR83-05 UNR83 Contents

Regulation	1.	Scope
	2.	Definitions
	3.	Application for approval
	4.	Approval
	5.	Specifications and tests
	6.	Modifications of the vehicle type
	7.	Extensions to type approvals
	8.	Conformity of production (COP)
	9.	In-service conformity
	10.	Penalties for non-conformity of production
	11.	Production definitively discontinued
	12.	Transitional provisions
	13.	Names and addresses of Technical Services
Annexes	1	Engine and vehicle characteristics and information concerning the conduct of tests
	2	Communication
	3	Arrangements of the approval mark
	4a	Type I test
	5	Type II test
	6	Type III test
	7	Type IV test
	8	Type VI test
	9	Type V test
	10	Specifications of reference fuels
	10a	Specifications of gaseous reference fuels
	11	On-Board Diagnostics (OBD) for motor vehicles
	12	Granting of an ECE type approval for a vehicle fuelled by LPG or NG/biomethane
	13	Emissions test procedure for a vehicle equipped with a periodically regenerating system
	14	Emissions test procedure for Hybrid Electric Vehicles (HEV)

5. Specifications and Tests
5.1 General
5.2 Test procedure
5.3. Description of tests

Annex 4. Type I test procedure

5.3. **Description of tests**

5.3.1. Type I test (Verifying exhaust emissions after a cold start).

5.3.1.1. Figure 1 illustrates the routes for Type I test. This test shall be carried out on all vehicles referred to in paragraph 1.

5.3.1.2. The vehicle is placed on a chassis dynamometer equipped with a means of load and inertia simulation.

5.3.1.2.1. A test lasting a total of 19 minutes and 40 seconds, made up of two parts, One and Two, is performed without interruption. An unsampled period of not more than 20 seconds may, with the agreement of the manufacturer, be introduced between the end of Part One and the beginning of Part Two in order to facilitate adjustment of the test equipment.

5.3.1.2.1.1. Vehicles that are fuelled with LPG or NG/biomethane shall be tested in the Type I test for variation in the composition of LPG or NG/biomethane, as set out in Annex 12 to this Regulation. Vehicles that can be fuelled either with petrol or LPG or NG/biomethane shall be tested on both the fuels, tests on LPG or NG/biomethane being performed for variation in the composition of LPG or NG/biomethane, as set out in Annex 12 to this Regulation.

5.3.1.2.1.2. Notwithstanding the requirement of paragraph 5.3.1.2.1.1., vehicles that can be fuelled with either petrol or a gaseous fuel, but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the Type I test as vehicles that can only run on a gaseous fuel.

5.3.1.2.2. Part One of the test is made up of four elementary urban cycles. Each elementary urban cycle comprises fifteen phases (idling, acceleration, steady speed, deceleration, etc.).

5.3.1.2.3. Part Two of the test is made up of one extra-urban cycle. The extra-urban cycle comprises 13 phases (idling, acceleration, steady speed, deceleration, etc.).

5.3.1.2.4. During the test the exhaust gases are diluted and a proportional sample collected in one or more bags. The exhaust gases of the vehicle tested are diluted, sampled and analysed, following the procedure described below, and the total volume of the diluted exhaust is measured. Not only are the carbon monoxide, hydrocarbon and nitrogen oxide emissions recorded, but also the particulate pollutant emissions from vehicles equipped with compression-ignition engines.

5.3.1.3. The test is carried out using the procedure of Type I test as described in Annex 4a to this Regulation. The method used to collect and analyse the gases is prescribed in Appendix 2 and Appendix 3 to Annex 4a to this Regulation, and the method to sample and analyse the particulates shall be as prescribed in Appendix 4 and Appendix 5 to Annex 4a to this Regulation.

5.3.1.4. Subject to the requirements of paragraph 5.3.1.5. the test shall be repeated three times. The results are multiplied by the appropriate deterioration factors obtained from Table 3 of paragraph 5.3.6. and, in the case of periodically regenerating systems as defined in paragraph 2.20., shall also be multiplied by the factors Ki obtained from Annex 13 to this Regulation. The resulting masses of gaseous emissions and the mass of and number of particulates obtained shall be less than the limits shown in Table 1:

Regulation 5. Specifications and tests

Limit Values

			Reference mass (RW) (kg)	Mass of carbon monoxide (CO)		Mass of hydrocarbons (HC)		Mass of oxides of nitrogen (NO_x)		Combined mass of hydrocarbons and oxides of nitrogen ($HC + NO_x$)		Mass of particulates (1)(PM)
				L_1 (g/km)		L_2 (g/km)		L_3 (g/km)		$L_2 + L_3$ (g/km)		L_4 (g/km)
Category		Class		Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel
A (2000)	M(2)	-	All	2.3	0.64	0.20	-	0.15	0.50	-	0.56	0.05
	N_1(3)	I	RW≤1,305 kg	2.3	0.64	0.20	-	0.15	0.50	-	0.56	0.05
		II	1,305 < RW ≤1,760 kg	4.17	0.80	0.25	-	0.18	0.65	-	0.72	0.07
		III	1,760 < RW	5.22	0.95	0.29	-	0.21	0.78	-	0.86	0.10
B (2005)	M(2)		All	1.0	0.50	0.10	-	0.08	0.25	-	0.30	0.025
	N_1(3)		RW≤1,305 kg	1.0	0.50	0.10	-	0.08	0.25	-	0.30	0.025
			1,305 < RW ≤ 1,760 kg	1.81	0.63	0.13	-	0.10	0.33	-	0.39	0.04
			1,760 < RW	2.27	0.74	0.16	-	0.11	0.39	-	0.46	0.06

(1) For compression-ignition engines.
(2) Except vehicles the maximum mass of which exceeds 2,500 kg.
(3) And those category M vehicles which are specified in note (2).

5.3.1.4.1. Notwithstanding the requirements of paragraph 5.3.1.4., for each pollutant or combination of pollutants, one of the three resulting masses obtained may exceed, by not more than 10 per cent, the limit prescribed, provided the arithmetical mean of the three results is below the prescribed limit. Where the prescribed limits are exceeded for more than one pollutant, it is immaterial whether this occurs in the same test or in different tests.

5.3.1.4.2. When the tests are performed with gaseous fuels, the resulting mass of gaseous emissions shall be less than the limits for petrol-engined vehicles in the Table 1.

5.3.1.5. The number of tests prescribed in paragraph 5.3.1.4. is reduced in the conditions hereinafter defined, where V1 is the result of the first test and V2 the result of the second test for each pollutant or for the combined emission of two pollutants subject to limitation.

5.3.1.5.1. Only one test is performed if the result obtained for each pollutant or for the combined emission of two pollutants subject to limitation, is less than or equal to 0.70 L (i.e. $V1 \leqq 0.70\ L$).

5.3.1.5.2. If the requirement of paragraph 5.3.1.5.1. is not satisfied, only two tests are performed if, for each pollutant or for the combined emission of two pollutants subject to limitation, the following requirements are met:

$V1 \leqq 0.85\ L$ and $V1 + V2 \leqq 1.70\ L$ and $V2 \leqq L$.

Explanation of the UNR83-05

Annex 4

TYPE I TEST

Verifying exhaust emissions after a cold start

1. INTRODUCTION

This annex describes the procedure for the Type I test defined in paragraph 5.3.1. of this Regulation. When the reference fuel to be used is LPG or NG, the provisions of Annex

12 shall apply additionally. When the vehicle is equipped with a periodically regenerating system as defined in paragraph 2.20., the provisions of Annex 13 shall apply.

2. OPERATING CYCLE ON THE CHASSIS DYNAMOMETER

2.1. Description of the cycle

The operating cycle on the chassis dynamometer shall be that indicated in the Appendix 2 to this annex.

2.2. General conditions under which the cycle is carried out

Preliminary testing cycles should be carried out if necessary to determine how best to actuate the accelerator and brake controls so as to achieve a cycle approximating to the theoretical cycle within the prescribed limits.

2.3. Use of the gearbox

2.3.1. If the maximum speed which can be attained in first gear is below 15 km/h, the second, third and fourth gears shall be used for the urban cycle (Part One) and the second, third, fourth and fifth gears for the extra-urban cycle (Part Two). The second, third and fourth gears may also be used for the urban cycle (Part One) and the second, third, fourth and fifth gears for the extra-urban cycle (Part Two) when the manufacturer's instructions recommend starting in second gear on level ground, or when first gear is therein defined as a gear reserved for cross-country driving, crawling or towing.

Vehicles which do not attain the acceleration and maximum speed values required in the operating cycle shall be operated with the accelerator control fully depressed until they once again reach the required operating curve. Deviations from the operating cycle shall be recorded in the test report.

2.3.2. Vehicles equipped with semi-automatic-shift gearboxes shall be tested by using the gears normally employed for driving, and the gear shift is used in accordance with the manufacturer's instructions.

2.3.3. Vehicles equipped with automatic-shift gearboxes shall be tested with the highest gear ("Drive") engaged. The accelerator shall be used in such a way as to obtain the steadiest acceleration possible, enabling the various gears to be engaged in the normal order. Furthermore, the gear-change points shown in Appendix 1 to this annex shall not apply; acceleration shall continue throughout the period represented by the straight line connecting the end of each period of idling with the beginning of the next following period of steady speed. The tolerances given in paragraph 2.4. below shall apply.

2.3.4. Vehicles equipped with an overdrive which the driver can actuate shall be tested with the overdrive out of action for the urban cycle (Part One) and with the overdrive in action for the extra-urban cycle (Part Two).

2.3.5. At the request of the manufacturer, for a vehicle type where the idle speed of the engine is higher than the engine speed that would occur during operations 5, 12 and 24 of the elementary urban cycle (Part One), the clutch may be disengaged during the previous operation.

2.4. Tolerances

2.4.1. A tolerance of +/- 2 km/h shall be allowed between the indicated speed and the theoretical speed during acceleration, during steady speed, and during deceleration when the vehicle's brakes are used. If the vehicle decelerates more rapidly without the use of the brakes, only the provisions of paragraph 6.5.3. below shall apply. Speed tolerances greater than those prescribed shall be accepted during phase changes provided that the tolerances are never exceeded for more than 0.5 s on any one occasion.

2.4.2. The time tolerances shall be +/- 1.0 s. The above tolerances shall apply equally at the beginning and at the end of each gear-changing period 1/ for the urban cycle (Part One) and for the operations Nos. 3, 5 and 7 of the extra-urban cycle (Part Two).

2.4.3. The speed and time tolerances shall be combined as indicated in Appendix 1 to this annex.

3. VEHICLE AND FUEL

3.1. Test vehicle

3.1.1. The vehicle shall be presented in good mechanical condition. It shall have been run-in and driven at least 3,000 km before the test.

3.1.2. The exhaust device shall not exhibit any leak likely to reduce the quantity of gas collected, which quantity shall be that emerging from the engine.

3.1.3. The tightness of the intake system may be checked to ensure that carburation is not affected by an accidental intake of air.

3.1.4. The settings of the engine and of the vehicle's controls shall be those prescribed by the manufacturer. This requirement also applies, in particular, to the settings for idling (rotation speed and carbon monoxide content of the exhaust gases), for the cold start device and for the exhaust gas cleaning system.

3.1.5. The vehicle to be tested, or an equivalent vehicle, shall be fitted, if necessary, with a device to permit the measurement of the characteristic parameters necessary for chassis dynamometer setting, in conformity with paragraph 4.1.1. of this annex.

3.1.6. The technical service responsible for the tests may verify that the vehicle's performance conforms to that stated by the manufacturer, that it can be used for normal driving and, more particularly, that it is capable of starting when cold and when hot.

3.2. Fuel

When testing a vehicle against the emission limit values given in row A of the table in paragraph 5.3.1.4. of this Regulation, the appropriate reference fuel must comply with the specifications given in paragraph 1. of Annex 10 or, in the case of gaseous reference fuels, either paragraph 1.1.1. or paragraph 1.2. of Annex 10a.

When testing a vehicle against the emission limit values given in row B of the table in paragraph 5.3.1.4. of this Regulation, the appropriate reference fuel must comply with the specifications given in paragraph 2. of Annex 10 or, in the case of gaseous reference fuels, either paragraph 1.1.2. or paragraph 1.2. of Annex 10a.

3.2.1. Vehicles that are fuelled either with petrol or with LPG or NG shall be tested according to Annex 12 with the appropriate reference fuel(s) as defined in Annex 10a.

4. TEST EQUIPMENT

4.1. Chassis dynamometer

4.1.1. The dynamometer shall be capable of simulating road load within one of the following classifications:

dynamometer with fixed load curve, i.e. a dynamometer whose physical characteristics provide a fixed load curve shape,

dynamometer with adjustable load curve, i.e. a dynamometer with at least two road load parameters that can be adjusted to shape the load curve.

4.1.2. The setting of the dynamometer shall not be affected by the lapse of time. It shall not produce any vibrations perceptible to the vehicle and likely to impair the vehicle's normal operations.

4.1.3. It shall be equipped with means to simulate inertia and load. These simulators are connected to the front roller in the case of a two-roller dynamometer.

4.1.4. Accuracy

4.1.4.1. It shall be possible to measure and read the indicated load to an accuracy of +/- 5 per cent.

4.1.4.2. In the case of a dynamometer with a fixed load curve, the accuracy of the load setting at 80 km/h shall be +/- 5 per cent. In the case of a dynamometer with adjustable load curve, the accuracy of matching dynamometer load to road load shall be +/- 5 per cent at 120, 100, 80, 60, and 40 km/h and +/- 10 per cent at 20 km/h. Below this, dynamometer absorption shall be positive.

4.1.4.3. The total inertia of the rotating parts (including the simulated inertia where applicable) shall be known and shall be within +/- 20 kg of the inertia class for the test.

4.1.4.4. The speed of the vehicle shall be measured by the speed of rotation of the roller (the front roller in the case of a two-roller dynamometer). It shall be measured with an accuracy of +/- 1 km/h at speeds above 10 km/h.

4.1.4.5. The distance actually driven by the vehicle shall be measured by the movement of rotation of the roller (the front roller in the case of a two-roller dynamometer).

4.1.5. Load and inertia setting

4.1.5.1. Dynamometer with fixed load curve: the load simulator shall be adjusted to absorb the power exerted on the driving wheels at a steady speed of 80 km/h and the absorbed power at 50 km/h shall be noted. The means by which this load is determined and set are described in Appendix 3 to this annex.

4.1.5.2. Dynamometer with adjustable load curve: the load simulator shall be adjusted in order to absorb the power exerted on the driving wheels at steady speeds of 120, 100, 80, 60 and 40 and 20 km/h. The means by which these loads are determined and set are described in Appendix 3 to this annex.

4.1.5.3. Inertia

Dynamometers with electric inertia simulation shall be demonstrated to be equivalent to mechanical inertia systems. The means by which equivalence is established are described in Appendix 4 to this annex.

4.2. Exhaust gas-sampling system

4.2.1. The exhaust gas sampling system shall be able to measure the actual quantities of pollutants emitted in the exhaust gases to be measured. The system that shall be used is the constant volume sampler (CVS) system. This requires that the vehicle exhaust be continuously diluted with ambient air under controlled conditions. In the constant volume sampler concept of measuring mass emissions, two conditions shall be satisfied, the total volume of the mixture of exhaust and dilution air shall be measured and a continuously proportional sample of the volume shall be collected for analysis. The quantities of pollutants are determined from the sample concentrations, corrected for the pollutant content of the ambient air and the totalised flow over the test period.

The particulate pollutant emission level is determined by using suitable filters to collect the particulates from a proportional part flow throughout the test and determining the quantity thereof gravimetrically in accordance with paragraph 4.3.1.1.

4.2.2. The flow through the system shall be sufficient to eliminate water condensation at all conditions which may occur during a test, as defined in Appendix 5 to this annex.

4.2.3. Appendix 5 gives examples of three types of constant volume sampler system which satisfy the requirements of this annex.

4.2.4. The gas and air mixture shall be homogeneous at point S2 of the sampling probe.

4.2.5. The probe shall extract a true sample of the diluted exhaust gases

4.2.6. The system shall be free of gas leaks. The design and materials shall be such that the system does not influence the pollutant concentration in the diluted exhaust gas. Should any component (heat exchanger, blower, etc.) change the concentration of any pollutant gas in the diluted gas, the sampling for that pollutant shall be carried out before that component if the problem cannot be corrected.

4.2.7. If the vehicle being tested is equipped with an exhaust pipe comprising several branches, the connecting tubes shall be connected as near as possible to the vehicle without adversely affecting his operation.

4.2.8. Static pressure variations at the exhaust(s) of the vehicle shall remain within +/- 1.25 kPa of the static pressure variations measured during the dynamometer driving cycle and with no connection to the exhaust(s). Sampling systems capable of maintaining the static pressure to within +/- 0.25 kPa are used if a written request from a manufacturer to the administration granting the approval substantiates the need for the closer tolerance. The back-pressure shall be measured in the exhaust pipe as near as possible to its end or in an extension having the same diameter.

4.2.9. The various valves used to direct the exhaust gases shall be of a quick-adjustment, quick-acting type.

4.2.10. The gas samples are collected in sample bags of adequate capacity. These bags shall be made of such materials as will not change the pollutant gas by more than +/- 2 per cent after 20 minutes of storage.

4.3. Analytical equipment

4.3.1. Provisions

4.3.1.1. Pollutant gases shall be analysed with the following instruments: Carbon monoxide (CO) and carbon dioxide (CO2)analysis:

Analysers shall be of the non-dispersive infra-red (NDIR) absorption type.

Hydrocarbons (HC) analysis - spark-ignition engines:

The analyser shall be of the flame ionisation (FID) type calibrated with propane gas expressed equivalent to carbon atoms (C1).

Hydrocarbons (HC) analysis - compression-ignition engines:

The analyser shall be of the flame ionisation type with detector, valves, pipework, etc., heated to 463 degrees K (190 degrees C) +/- 10 degrees K (HFID). It shall be calibrated with propane gas expressed equivalent to carbon atoms (C1).

Nitrogen oxide (NOx) analysis:

The analyser shall be either of the chemi-luminescent (CLA) or of the non-dispersive ultra-violet resonance absorption (NDUVR) type, both with an NOx-NO converter.

Particulates - Gravimetric determination of the particulates collected:

These particulates shall in each case be collected by two series-mounted filters in the sample gas flow. The quantity of particulates collected by each pair of filters shall be as follows:

$$M = \frac{V_{mix}}{V_{ep} \cdot d} \cdot m \rightarrow m = M.d.\frac{V_{ep}}{V_{mix}}$$

where:

Vep : flow through filters;
Vmix : flow through tunnel;
M : particulate mass (g/km);
Mlimit : limit mass of particulates (limit mass in force, g/km);
m : mass of particulates collected by filters (g);
d : distance corresponding to the operating cycle km).

The particulates sample rate (Vep/Vmix) shall be adjusted so that for M = Mlimit, 1 < m< 5 mg (when 47 mm diameter filters are used).

The filter surface shall consist of a material that is hydrophobic and inert towards the components of the exhaust gas (fluorocarbon coated glass fibre filters or equivalent).

4.3.1.2. Accuracy

The analysers shall have a measuring range compatible with the accuracy required to measure the concentrations of the exhaust gas sample pollutants.

Measurement error shall not exceed +/- 2 per cent (intrinsic error of analyser) disregarding the true value for the calibration gases.

For concentrations of less than 100 ppm the measurement error shall not exceed +/- 2 ppm.

The ambient air sample shall be measured on the same analyser with an appropriate range.

The microgram balance used to determine the weight of all filters shall have accuracy of 5 micrograms (standard deviation) and readability of 1 microgram.

4.3.1.3. Ice-trap

No gas drying device shall be used before the analysers unless shown to have no effect on the pollutant content of the gas stream.

4.3.2. Particular requirements for compression-ignition engines

A heated sample line for a continuous HC-analysis with the flame ionisation detector (HFID), including recorder (R) shall be used. The average concentration of the measured hydrocarbons shall be determined by integration. Throughout the test, the temperature of the heated sample line shall be controlled at 463 degrees K (190 degrees C) +/- 10 degrees K. The heated sampling line shall be fitted with a heated filter (FH) 99 per cent efficient with particles > 0.3 micrometres, to extract any solid particles from the continuous flow of gas required for analysis.

The sampling system response time (from the probe to the analyser inlet) shall be no more than four seconds.

The HFID shall be used with a constant flow (heat exchanger) system to ensure a representative sample, unless compensation for varying CFV or CFO flow is made.

The particulate sampling unit shall consist of a dilution tunnel, a sampling probe, a filter unit, a partial-flow pump, and flow rate regulators and measuring units. The particulate- sampling part flow is drawn through two series-mounted filters. The sampling probe for the test gas flow for particulates shall be so arranged within the dilution tract that a representative sample gas flow can be taken from the homogeneous air/exhaust mixture and an air/exhaust gas mixture temperature of 325 degrees K (52 degrees C) is not exceeded immediately before the particulate filter. The temperature of the gas flow in the flow metre may not fluctuate by more than +/- 3 degrees K, nor may the mass flow rate fluctuate by more than +/- 5 per cent. Should the volume of flow change unacceptably as a result of excessive filter loading, the test shall be stopped. When it is repeated, the rate of flow shall be decreased and/or a larger filter used. The filters shall

be removed from the chamber no earlier than an hour before the test begins.

The necessary particle filters shall be conditioned (as regards temperature and humidity) in an open dish which has been protected against dust ingress for at least 8 and for not more than 56 hours before the test in an air-conditioned chamber. After this conditioning the uncontaminated filters will be weighed and stored until they are used. If the filters are not used within one hour of their removal from the weighing chamber they shall be re-weighed.

The one-hour limit may be replaced by an eight-hour limit if one or both of the following conditions are met;

a stabilised filter is placed and kept in a sealed filter holder assembly with the ends plugged, or;

a stabilised filter is placed in a sealed filter holder assembly which is then immediately placed in a sample line through which there is no flow.

4.3.3. Calibration

Each analyser shall be calibrated as often as necessary and in any case in the month before type approval testing and at least once every six months for verifying conformity of production.

The calibration method to be used is described in Appendix 6 to this annex for the analysers referred to in paragraph 4.3.1. above.

4.4. Volume measurement

4.4.1. The method of measuring total dilute exhaust volume incorporated in the constant volume sampler shall be such that measurement is accurate to +/- 2 per cent.

4.4.2. Constant volume sampler calibration

The constant volume sampler system volume measurement device shall be calibrated by a method sufficient to ensure the prescribed accuracy and at a frequency sufficient to maintain such accuracy.

An example of a calibration procedure which will give the required accuracy is given in Appendix 6 to this annex. The method shall utilise a flow metering device which is dynamic and suitable for the high flow-rate encountered in constant volume sampler testing. The device shall be of certified accuracy traceable to an approved national or international standard.

4.5. Gases

4.5.1. Pure gases

The following pure gases shall be available, if necessary, for calibration and operation: purified nitrogen:

(purity: +/- 1 ppm C, +/- 1 ppm CO, +/- 400 ppm CO2, +/- 0.1 ppm NO); purified synthetic air:

(purity: +/- 1 ppm C, +/- 1 ppm CO, +/- 400 ppm CO2, +/- 0.1 ppm NO); oxygen content between 18 and 21 per cent volume;

purified oxygen: (purity > 99.5 per cent vol. O2); purified hydrogen (and mixture containing helium):

(purity +/- 1 ppm C, +/- 400 ppm CO2).

carbon monoxide: (minimum purity 99.5 per cent) propane: (minimum purity 99.5 per cent).

4.5.2. Calibration and span gases

Mixtures of gases having the following chemical compositions shall be available: C8 H8 and purified synthetic air (see paragraph 4.5.1. of this annex);

CO and purified nitrogen;

CO2 and purified nitrogen;

NO and purified nitrogen. (The amount of NO2 contained in this calibration gas shall not exceed 5 per cent of the NO content.)

The true concentration of a calibration gas shall be within +/- 2 per cent of the stated figure.

The concentrations specified in Appendix 6 to this annex may also be obtained by means of a gas divider, diluting with purified N2 or with purified synthetic air. The accuracy of the mixing device shall be such that the concentrations of the diluted calibration gasesmay be determined to within +/- 2 per cent.

4.6. Additional equipment

4.6.1. Temperatures

The temperatures indicated in Appendix 8 shall be measured with an accuracy of +/- 1.5 degrees K.

4.6.2. Pressure

The atmospheric pressure shall be measurable to within +/- 0.1 kPa.

4.6.3. Absolute humidity

The absolute humidity (H) shall be measurable to within +/- 5 per cent.

The exhaust gas-sampling system shall be verified by the method described in paragraph 3. of Appendix 7 to this annex.

The maximum permissible deviation between the quantity of gas introduced and the quantity of gas measured is 5 per cent.

5. PREPARING THE TEST

5.1. Adjustment of inertia simulators to the vehicle's translatory inertias

An inertia simulator shall be used enabling a total inertia of the rotating masses to be obtained proportional to the reference mass within the following limits:

Explanation of the UNR83-05 Annex 4 Type I Test

Reference mass of vehicle RW(kg)	Equivalent inertia I (kg)
RW ≤ 480	455
480 < RW ≤ 540	510
540 < RW ≤ 595	570
595 < RW ≤ 650	625
650 < RW ≤ 710	680
710 < RW ≤ 765	740
765 < RW ≤ 850	800
850 < RW ≤ 965	910
965 < RW ≤ 1,080	1,020
1,080 < RW ≤ 1,190	1,130
1,190 < RW ≤ 1,305	1,250
1,305 < RW ≤ 1,420	1,360
1,420 < RW ≤ 1,530	1,470
1,530 < RW ≤ 1,640	1,590
1,640 < RW ≤ 1,760	1,700
1,760 < RW ≤ 1,870	1,810
1,870 < RW ≤ 1,980	1,930
1,980 < RW ≤ 2,100	2,040
2,100 < RW ≤ 2,210	2,150
2,210 < RW ≤ 2,380	2,270
2,380 < RW ≤ 2,610	2,270
2,610 < RW	2,270

If the corresponding equivalent inertia is not available on the dynamometer, the larger value closest to the vehicle reference mass will be used.

5.2. Setting of dynamometer

The load shall be adjusted according to methods described in paragraph 4.1.5. above.

The method used and the values obtained (equivalent inertia - characteristic adjustment parameter) shall be recorded in the test report.

5.3. Conditioning of vehicle

5.3.1. For compression-ignition engined vehicles for the purpose of measuring particulates, at most 36 hours and at least 6 hours before testing, the Part Two cycle described in Appendix 1 to this annex shall be used. Three consecutive cycles shall be driven. The dynamometer setting shall be indicated in paragraphs 5.1. and 5.2. above.

At the request of the manufacturer, vehicles fitted with positive-ignition engines may be preconditioned with one Part One and two Part Two driving cycles.

After this preconditioning, specific for compression-ignition engines, and before testing, compression-ignition and positive-ignition engined vehicles shall be kept in a room in which the temperature remains relatively constant between 293 and 303 degrees K (20 and 30 degrees C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within +/- 2 degrees K of the temperature of the room.

5.3.1.1. If the manufacturer so requests, the test shall be carried out not later than 30 hours after the vehicle has been run at its normal temperature.

5.3.1.2. For positive-ignition engined vehicles fuelled with LPG or NG or so equipped that they can be fuelled with either petrol or LPG or NG, between the tests on the first gaseous reference fuel and the second gaseous reference fuel, the vehicle shall be preconditioned before the test on the second reference fuel. This preconditioning is done on the second reference fuel by driving a preconditioning cycle consisting of one Part One (urban part) and two times Part Two (extra-urban part) of the test cycle described in Appendix 1 to this annex. On the manufacturer's request and with the agreement of the technical service this preconditioning may be extended. The dynamometer setting shall be the one indicated in paragraphs 5.1. and 5.2. of this annex.

5.3.2. The tyre pressures shall be the same as that specified by the manufacturer and used for the preliminary road test for brake adjustment. The tyre pressure may be increased by up to 50 per cent from the manufacturer's recommended setting in the case of a two- roller dynamometer. The actual pressure used shall be recorded in the test report.

6. PROCEDURE FOR BENCH TESTS

6.1. Special conditions for carrying out the cycle

6.1.1. During the test, the test cell temperature must be between 293 degrees K and 303 degrees K (20 degrees and 30 degrees C). The absolute humidity (H) of either the air in the test cell or the intake air of the engine shall be such that:

$5.5 < H < 12.2$ (g H20/kg dry air)

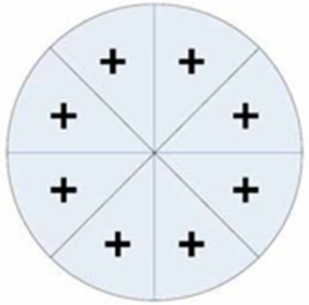
6.1.2. The vehicle shall be approximately horizontal during the test so as to avoid any abnormal distribution of the fuel.

6.1.3. A current of air of variable speed shall be blown over the vehicle. The blower speed shall be within the operating range of 10 km/h to at least 50 km/h, or as an alternative, at the request of the manufacturer, within the operating range of 10 km/h to at least the maximum speed of the test cycle being used. The linear velocity of the air at the blower outlet shall be within +/-5 km/h of the corresponding roller speed within the range of 10 km/h to 50 km/h. At the range over 50 km/h, the linear velocity of the air shall be within +/-10 km/h of the corresponding roller speed. At roller speeds of less than 10 km/h, air velocity may be zero.

The above mentioned air velocity shall be determined as an averaged value of a number of measuring points which:

(a) For blowers with rectangular outlets are located at the centre of each rectangle dividing the whole of the blower outlet into 9 areas (dividing both horizontal and vertical sides of the blower outlet into 3 equal parts);

(b) For circular blower outlets, the outlet shall be divided into 8 equal arcs by vertical, horizontal and 45 degrees lines. The measurement points lie on the radial centre line of each arc (22.5 degrees) at a radius of two thirds of the total (as shown in the diagram below).



Each value at those points shall be within 10 per cent of the averaged value of themselves.

The device used to measure the linear velocity of the air shall be located at between 0 and 20 cm from the air outlet.

The final selection of the blower shall have the following characteristics:

(i) Area: at least 0.2 m2;

(ii) Height of the lower edge above ground: approximately 20 cm;

(iii) Distance from the front of the vehicle: approximately 30 cm.

As an alternative, at the request of the manufacturer the blower speed shall be fixed at an air speed of at least 6 m/s (21.6 km/h).

The height and lateral position of the cooling fan can also be modified at the request of the manufacturer.

6.1.4. During the test the speed is recorded against time or collected by the data-acquisition system so that the correctness of the cycles performed can be assessed.

6.2. Starting-up the engine

6.2.1. The engine shall be started up by means of the devices provided for this purpose according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles.

6.2.2. The first cycle starts on the initiation of the engine start-up procedure.

6.2.3. In the case of the use of LPG or NG as a fuel it is permissible that the engine is started on petrol and switched to LPG or NG after a predetermined period of time which cannot be changed by the driver.

6.3. Idling

6.3.1. Manual-shift or semi-automatic gearbox, see Appendix 1 to this annex, tables 1.2 and 1.3.

6.3.2. Automatic-shift gearbox

After initial engagement the selector shall not be operated at any time during the test except in the case specified in paragraph 6.4.3. below or if the selector can actuate the overdrive, if any.

6.4. Accelerations

6.4.1. Accelerations shall be so performed that the rate of acceleration is as constant as possible throughout the operation.

6.4.2. If an acceleration cannot be carried out in the prescribed time, the extra time required shall be deducted from the time allowed for changing gear, if possible, but otherwise from the subsequent steady-speed period.

6.4.3. Automatic-shift gearboxes

If an acceleration cannot be carried out in the prescribed time, the gear selector shall operate in accordance with requirements for manual-shift gearboxes.

6.5. Decelerations

6.5.1. All decelerations of the elementary urban cycle (Part One) shall be effected by removing the foot completely from the accelerator, the clutch remaining engaged. The clutch shall be disengaged, without use of the gear lever, at the higher of the following speeds: 10 km/h or the speed corresponding to the engine idle speed.

All decelerations of the extra-urban cycle (Part Two) shall be effected by removing the foot completely from the accelerator, the clutch remaining engaged. The clutch shall be disengaged, without use of the gear lever, at a speed of 50 km/h for the last deceleration.

6.5.2. If the period of deceleration is longer than that prescribed for the corresponding phase, the vehicle's brakes shall be used to enable the timing of the cycle to be complied with.

6.5.3. If the period of deceleration is shorter than that prescribed for the corresponding phase, the timing of the theoretical cycle shall be restored by constant speed or idling period merging into the following operation.

6.5.4. At the end of the deceleration period (halt of the vehicle on the rollers) of the elementary urban cycle (Part One) the gears shall be placed in neutral and the clutch engaged.

6.6. Steady speeds

6.6.1. "Pumping" or the closing of the throttle shall be avoided when passing from acceleration to the following steady speed.

6.6.2. Periods of constant speed shall be achieved by keeping the accelerator position fixed.

7. PROCEDURE FOR SAMPLING AND ANALYSIS

7.1. Sampling

Sampling shall begin (BS) before or at the initiation of the engine start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES) or, in the case of test Type VI, on conclusion of the final idling period of the last elementary urban cycle (Part One).

7.2. Analysis

7.2.1. The exhaust gases contained in the bag shall be analysed as soon as possible and in any event not later than 20 minutes after the end of the test cycle. The spent particulate filters shall be taken to the chamber no later than one hour after conclusion of the test on the exhaust gases and shall there be conditioned for between 2 and 36 hours and then be weighed.

7.2.2. Prior to each sample analysis, the analyser range to be used for each pollutant shall be set to zero with the appropriate zero gas.

7.2.3. The analysers shall then be set to the calibration curves by means of span gases of nominal concentrations of 70 to 100 per cent of the range.

7.2.4. The analysers' zeros shall then be rechecked. If the reading differs by more than 2 per cent of the range from that set in paragraph 7.2.2. above, the procedure shall be repeated.

7.2.5. The samples shall then be analysed.

7.2.6. After the analysis, zero and span points shall be rechecked using the same gases. If these rechecks are within +/- 2 per cent of those in paragraph 7.2.3. above, the analysis shall be considered acceptable.

7.2.7. At all points in this paragraph, the flow-rates and pressures of the various gases shall be the same as those used during calibration of the analysers.

7.2.8. The figure adopted for the content of the gases in each of the pollutants measured shall be that read off after stabilisation of the measuring device. Hydrocarbon mass emissions of compression-ignition engines shall be calculated from the integrated HFID reading, corrected for varying flow if necessary, as shown in Appendix 5 to this annex.

8. DETERMINATION OF THE QUANTITY OF GASEOUS AND PARTICULATE POLLUTANTS EMITTED

8.1. The volume considered

The volume to be considered shall be corrected to conform to the conditions of 101.33 kPa and 273.2 degrees K.

8.2. Total mass of gaseous and particulate pollutants emitted

The mass M of each pollutant emitted by the vehicle during the test shall be determined by obtaining the product of the volumetric concentration and the volume of the gas in question, with due regard for the following densities under above-mentioned reference conditions:

In the case of carbon monoxide (CO): d = 1.25 g/l In the case of hydrocarbons:

(a) For E0 petrol ($CH_{1.85}$) d = 0.619 g/l

(b) For B0 diesel ($CH_{1.86}$) d = 0.619 g/l

(c) For LPG ($CH_{2.525}$) d = 0.649 g/l

(d) For NG (CH_4) d = 0.714 g/l

(e) For E5 petrol ($C_1H_{1.89}O_{0.016}$) d = 0.631 g/l

(f) For B5 diesel ($C_1H_{1.86}O_{0.005}$) d = 0.622 g/l

Annex 4 - Appendix 1

BREAKDOWN OF THE OPERATING CYCLE
USED FOR THE TYPE I TEST

Annex 4 - Appendix 1

BREAKDOWN OF THE OPERATING CYCLE USED FOR THE TYPE I TEST

1. OPERATING CYCLE

The operating cycle, made up of a Part One (urban cycle) and Part Two (extra-urban cycle), is illustrated in Figure 1/1.

2. ELEMENTARY URBAN CYCLE (Part One)

(See figure 1/2 and table 1.2.)

2.1. Breakdown by phases:

	Time (s)	per cent	
Idling	60	30.8	35.4
Idling, vehicle moving, clutch engaged on one combination	9	4.6	
Gear-changing	8	4.1	
Accelerations	36	18.5	
Steady-speed periods	57	29.2	
Decelerations	25	12.8	
	195	100	

2.2. Breakdown by use of gears

	Time (s)	per cent	
Idling	60	30.8	35.4
Idling, vehicle moving, clutch engaged on one combination	9	4.6	
Gear-changing	8	4.1	
First gear	24	12.3	
Second gear	53	27.2	
Third gear	41	21	
	195	100	

2.3. General information:

Average speed during test : 19 km/h
Effective running time : 195 s
Theoretical distance covered per cycle : 1.013 km
Equivalent distance for the four cycles : 4.052 km

Figure 1/1: Operating cycle for the Type I test

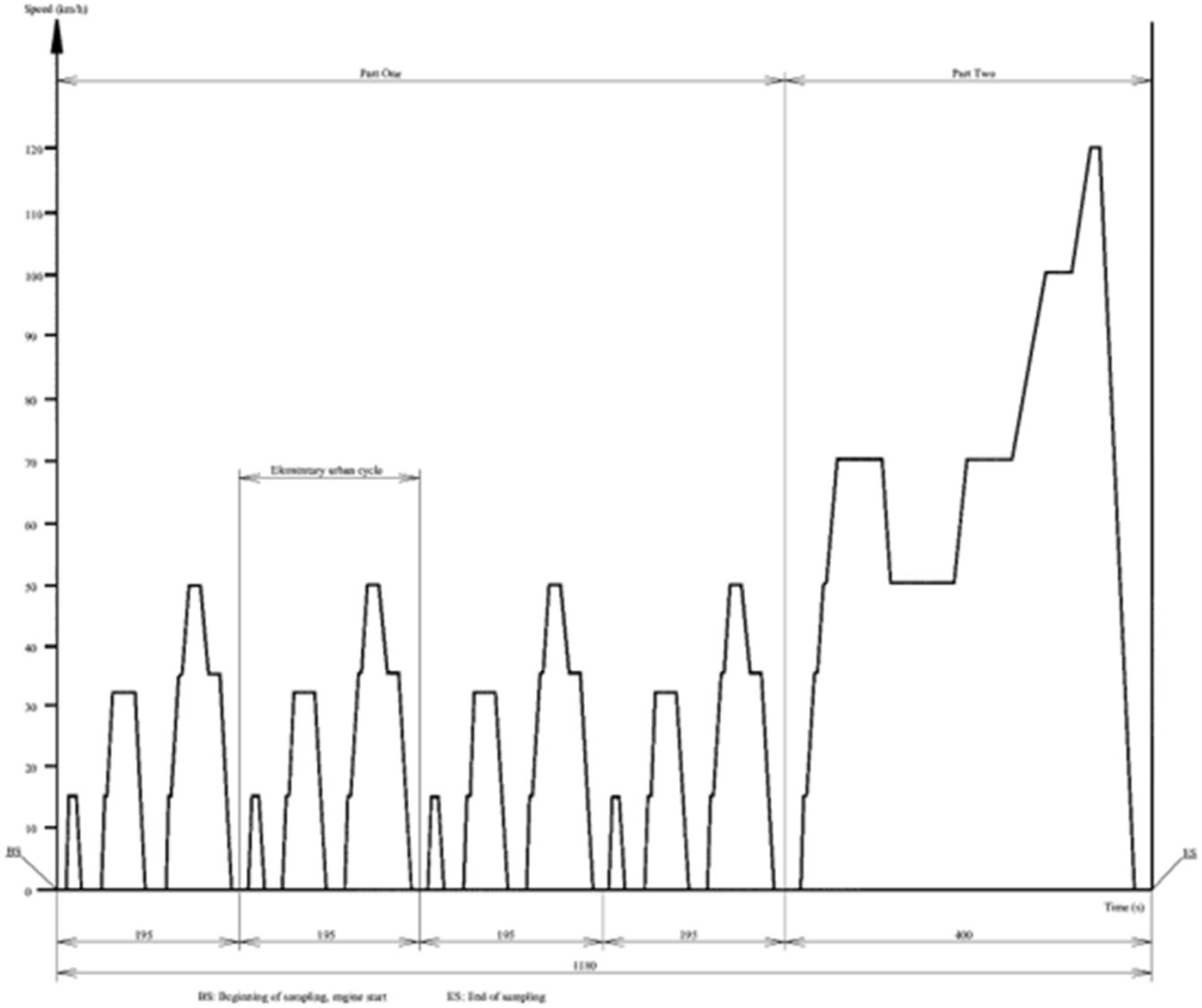


Table 1.2: Elementary urban operating cycle on the chassis dynamometer (Part One)

No. of operation	Operation	Phase	Acceleration (m/s^2)	Speed (km/h)
1	Idling	1		
2	Acceleration	2	1.04	0-15
3	Steady speed	3		15
4	Deceleration	4	-0.69	15-10
5	Deceleration, clutch disengaged		-0.92	10-0
6	Idling	5		
7	Acceleration	6	0.83	0-15
8	Gear change			
9	Acceleration		0.94	15-32
10	Steady speed	7		32
11	Deceleration	8	-0.75	32-10
12	Deceleration, clutch disengaged		-0.92	10-0
13	Idling	9	0-15	0-15
14	Acceleration	10		

Annex 4 Appendix 1

No. of operation	Operation	Phase	Acceleration (m/s^2)	Speed (km/h)
15	Gear change			
16	Acceleration		0.62	15-35
17	Gear change			
18	Acceleration		0.52	35-50
19	Steady speed	11		50
20	Deceleration	12	-0.52	50-35
21	Steady speed	13		35
22	Gear change	14		
23	Deceleration		-0.99	35-10
24	Deceleration clutch disengaged		-0.92	10-0
25	Idling	15		

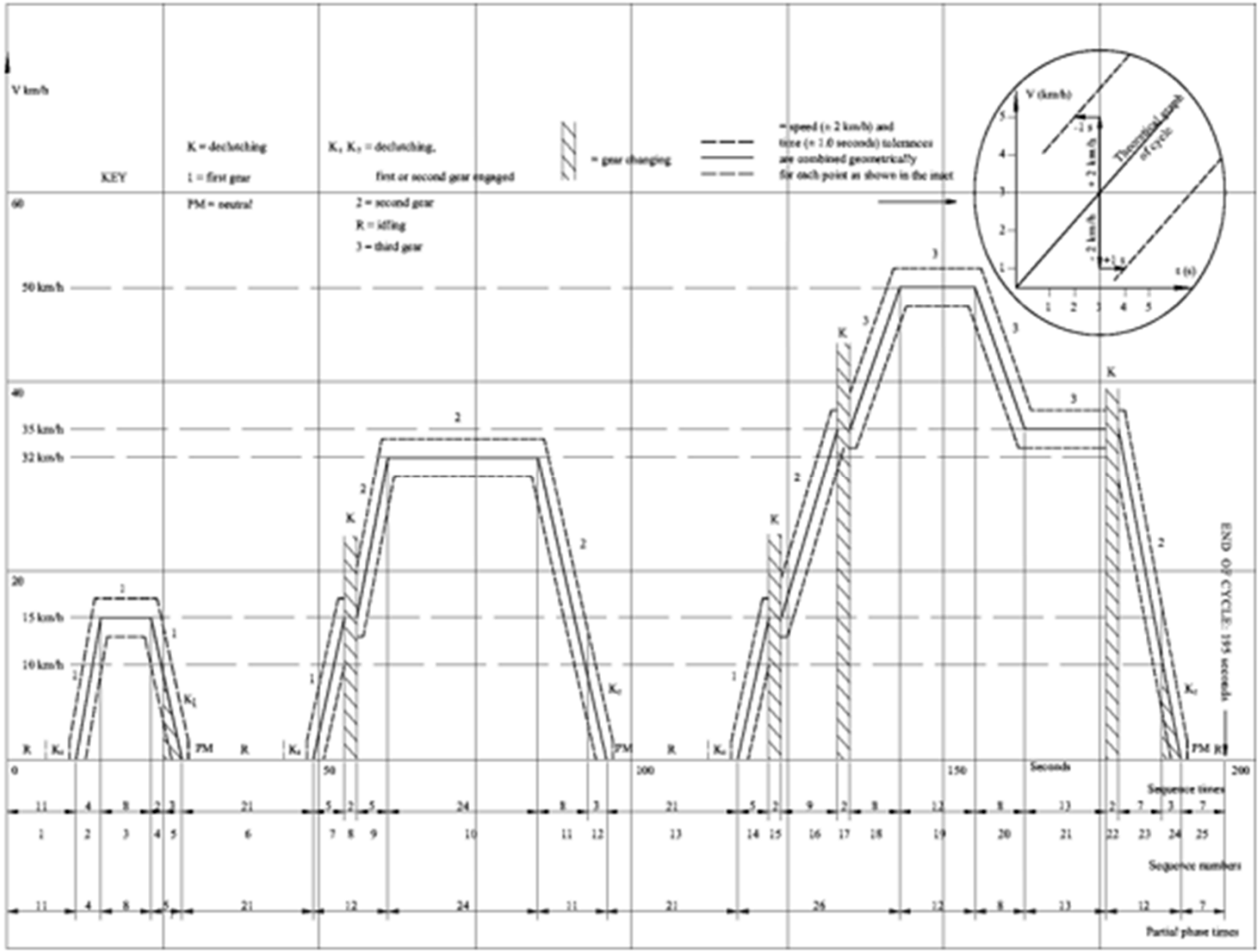
No. of operation	Duration of each		Cumulative time (s)	Gear to be used in the case of a manual gearbox
	Operation (s)	Phase (s)		
1	11	11	11	6 s PM + 5 s K_1 (*)
2	4	4	15	1
3	9	8	23	1
4	2	5	25	1
5	3		28	K_1 (*)
6	21	21	49	16 s PM + 5 s K_1 (*)
7	5	12	54	1
8	2		56	
9	5		61	2
10	24	24	85	2
11	8	11	93	2
12	3		96	K_2 (*)
13	21		117	16 s PM + 5 s K_1 (*)
14	5	26	122	1
15	2		124	
16	9		133	2
17	2		135	
18	8		143	3
19	12	12	155	3
20	8	8	163	3
21	13	13	176	3
22	2	12	178	

No. of operation	Duration of each		Cumulative time (s)	Gear to be used in the case of a manual gearbox
	Operation (s)	Phase (s)		
23	7		185	2
24	3		188	K_2 (*)
25	7	7	195	7 s PM (*)

(*) PM = gearbox in neutral, clutch engaged.

K_1, K_2 = first or second gear engaged, clutch disengaged.

Figure 1/2: Elementary urban cycle for the Type I test



3. EXTRA-URBAN CYCLE (Part Two)

(See Figure 1/3 and Table 1.3.)

3.1. Breakdown by phases:

	Time (s)	per cent
Idling:	20	5.0
Idling, vehicle moving, clutch engaged on one combination:	20	5.0
Gear-shift:	6	1.5
Accelerations:	103	25.8

	Time (s)	per cent
Steady-speed periods:	209	52.2
Decelerations:	42	10.5
	400	100

3.2. Breakdown by use of gears:

	Time (s)	per cent
Idling:	20	5.0
Idling, vehicle moving, clutch engaged on one combination:	20	5.0
Gear-shift:	6	1.5
First gear:	5	1.3
Second-gear	9	2.2
Third gear:	8	2
Fourth gear:	99	24.8
Fifth gear:	233	58.2
	400	100

3.3. General information

Average speed during test: 62.6 km/h
Effective running time: 400 s
Theoretical distance covered per cycle: 6.955 km
Maximum speed: 120 km/h
Maximum acceleration: 0.833 m/s2
Maximum deceleration: -1.389 m/s2

Table 1.3: Extra-urban cycle (Part Two) for the Type I test

No. of operation	Operation	Phase	Acceleration (m/s^2)	Speed (km/h)
1	Idling	1		
2	Acceleration	12	0.83	0
3	Gear change			
4	Acceleration		0.62	15-35
5	Gear change			
6	Acceleration		0.52	35-30
7	Gear change			
8	Acceleration		0.43	50-70
9	Steady speed	3		70
10	Deceleration	4	-0.69	70-50
11	Steady speed	5		50
12	Acceleration	6	0.43	50-70
13	Steady speed	7		70
14	Acceleration	8	0.24	70-100
15	Steady speed (2)	9		100
16	Acceleration (2)	10	0.28	100-120
17	Steady speed (2)	11		120
18	Deceleration (2)	12	-0.69	120-80
19	Deceleration (2)		-1.04	80-50
20	Deceleration, clutch disengaged		1.39	50-0
21	Idle	13		

(2) Additional gears can be used according to manufacturer recommendations if the vehicle is equipped with a transmission with more than five gears.

Annex 4 Appendix 1

No. of operation	Duration of each		Cumulative time (s)	Gear to be used in the case of a manual gearbox
	Operation (s)	Phase (s)		
1	20	20	20	K_1 (1)
2	5	41	25	1
3	2		27	-
4	9		36	2
5	2		38	-
6	8		46	3
7	2		48	-
8	13		61	4
9	50	50	111	5
10	8	8	119	4 s.5 + 4 s.4

Annex 4 Appendix 1

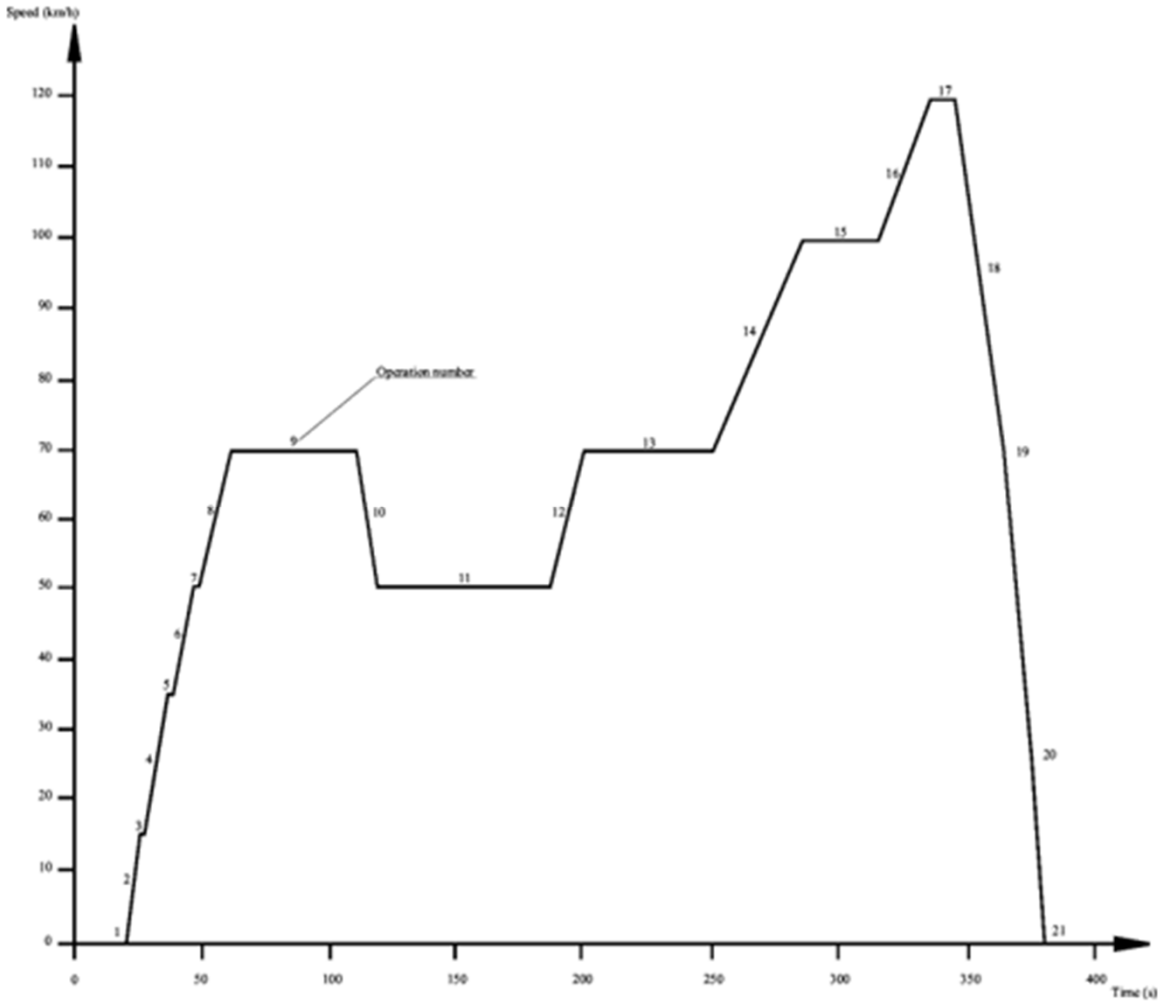
No. of operation	Duration of each		Cumulative time (s)	Gear to be used in the case of a manual gearbox
	Operation (s)	Phase (s)		
11	69	69	188	4
12	13	13	201	4
13	50	50	251	5
14	35	35	286	5
15	30	30	316	5 (2)
16	20	20	336	5 (2)
17	10	20	346	5 (2)
18	16	34	362	5 (2)
19	8		370	5 (2)
20	10		380	K5 (1)
21	20	20	400	PM (1)

(1) PM = gearbox on neutral, clutch engaged.

K_1 K_5 = first or fifth gear engaged, clutch disengaged

(2) Additional gears can be used according to manufacturer recommendations if the vehicle is equipped with a transmission with more than five gears.

Figure 1/3: Extra-urban cycle (Part Two) for the Type I test



Annex 4 - Appendix 2

CHASSIS DYNAMOMETER

Annex 4 - Appendix 2

CHASSIS DYNAMOMETER

1. **DEFINITION OF A CHASSIS DYNAMOMETER WITH FIXED LOAD CURVE**

1.1. Introduction

In the event that the total resistance to progress on the road cannot be reproduced on the chassis dynamometer between speeds of 10 km/h and 120 km/h, it is recommended that a chassis dynamometer having the characteristics defined below should be used.

1.2. Definition

1.2.1. The chassis dynamometer may have one or two rollers.

The front roller shall drive, directly or indirectly, the inertial masses and the power absorption device.

1.2.2. The load absorbed by the brake and the chassis dynamometer internal frictional effects between the speeds of 0 and 120 km/h is as follows:

F = (a + b.V2) +/- 0.1.F80 (without being negative)

where:

F = total load absorbed by the chassis dynamometer (N) a = value equivalent to rolling resistance (N)

b = value equivalent to coefficient of air resistance (N/(km/h)2)

V = speed (km/h)

F80 = load at 80 km/h (N).

2. METHOD OF CALIBRATING THE DYNAMOMETER

2.1. Introduction

This Appendix describes the method to be used to determine the load absorbed by a dynamometer brake. The load absorbed comprises the load absorbed by frictional effects and the load absorbed by the power-absorption device.

The dynamometer is brought into operation beyond the range of test speeds. The device used for starting up the dynamometer is then disconnected: the rotational speed of the driven roller decreases.

The kinetic energy of the rollers is dissipated by the power-absorption unit and by the frictional effects. This method disregards variations in the roller's internal frictional effects caused by rollers with or without the vehicle. The frictional effects of the rear roller shall be disregarded when the roller is free.

2.2. Calibration of the load indicator to 80 km/h as a function of the load absorbed.

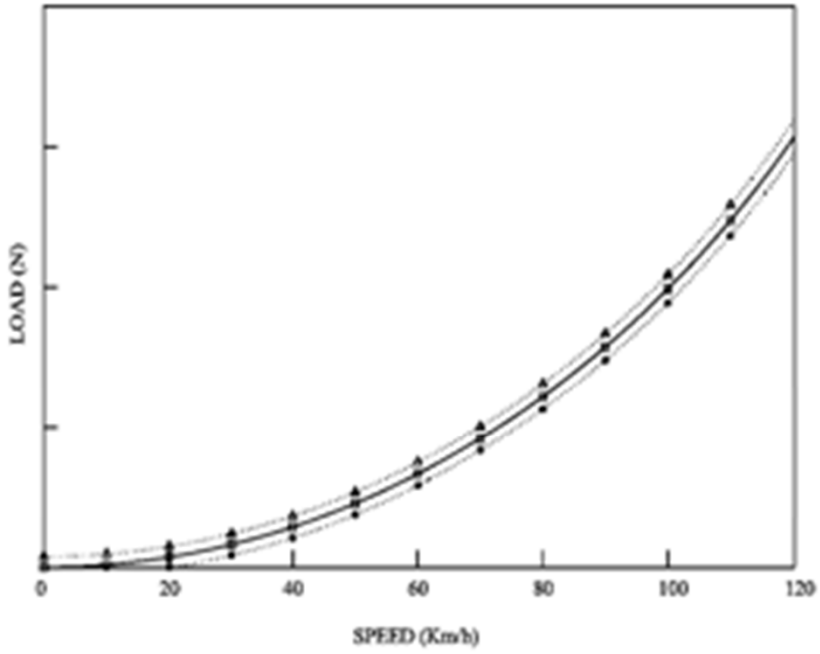
The following procedure shall be used (see also Figure 2/1):

2.2.1. Measure the rotational speed of the roller if this has not already been done. A fifth wheel, a revolution counter or some other method may be used.

2.2.2. Place the vehicle on the dynamometer or devise some other method of starting-up the dynamometer.

2.2.3. Use the flywheel or any other system of inertia simulation for the particular inertia class to be used.

Figure 2/1: Diagram illustrating the power absorbed by the chassis dynamometer



□ = $F = a + b \cdot V^2$ ● = $(a + b\,V^2) - 0.1 \cdot F_{80}$ △ = $(a + b \cdot V^2) + 0.1 \cdot F_{80}$

2.2.4. Bring the dynamometer to a speed of 80 km/h.

2.2.5. Note the load indicated Fi (N)

2.2.6. Bring the dynamometer to a speed of 90 km/h.

2.2.7. Disconnect the device used to start-up the dynamometer.

2.2.8. Note the time taken by the dynamometer to pass from a speed of 85 km/h to a speed of 75 km/h.

2.2.9. Set the power-absorption device at a different level.

2.2.10. The requirements of paragraphs 2.2.4. to 2.2.9. shall be repeated sufficiently often to cover the range of loads used.

2.2.11. Calculate the load absorbed using the formula:

$$F = \frac{M_i \cdot \Delta V}{t}$$

where:

F = load absorbed (N)

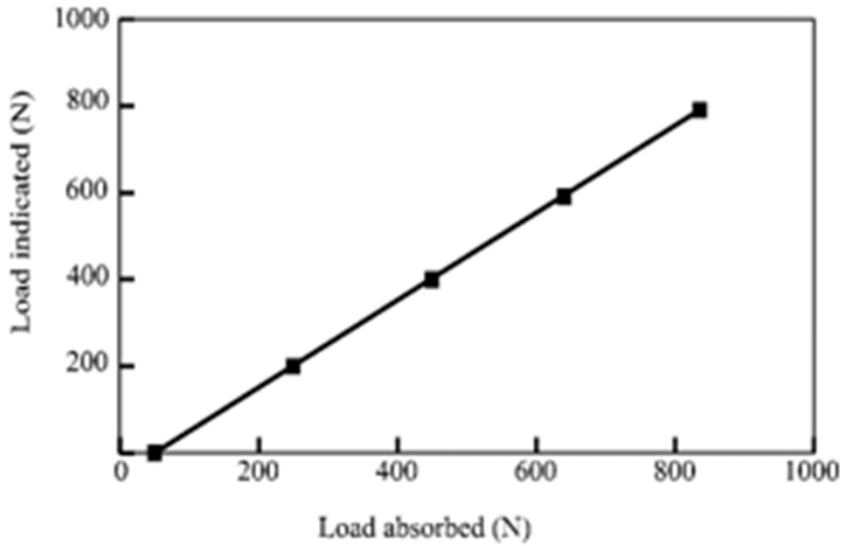
Mi = equivalent inertia in kg (excluding the inertial effects of the free rear roller)

delta V = Speed deviation in m/s (10 km/h = 2.775 m/s)

t = time taken by the roller to pass from 85 km/h to 75 km/h.

2.2.12.1. Figure 2/2 shows the load indicated at 80 km/h in terms of load absorbed at 80 km/h.

Figure 2/2: Load indicated at 80 km/h in terms of load absorbed at 80 km/h



2.2.13. The requirements of paragraphs 2.2.3. to 2.2.12. above shall be repeated for all inertia classes to be used.

2.3. Calibration of the load indicator as a function of the absorbed load for other speeds. The procedures described in paragraph 2.2. above shall be repeated as often as necessary for the chosen speeds.

2.4. Verification of the load-absorption curve of the dynamometer from a reference setting at a speed of 80 km/h

2.4.1. Place the vehicle on the dynamometer or devise some other method of starting-up the dynamometer.

2.4.2. Adjust the dynamometer to the absorbed load (F) at 80 km/h.

2.4.3. Note the load absorbed at 120, 100, 80, 60, 40 and 20 km/h.

2.4.4. Draw the curve F(V) and verify that it corresponds to the requirements of paragraph1.2.2. of this Appendix.

2.4.5. Repeat the procedure set out in paragraphs 2.4.1. to 2.4.4. above for other values of power F at 80 km/h and for other values of inertias.

2.5. The same procedure shall be used for force or torque calibration.

3. SETTING OF THE DYNAMOMETER

3.1. Setting method

3.1.1. Introduction

This method is not a preferred method and shall be used only with fixed load curve shape dynamometers for determination of load setting at 80 km/h and cannot be used for vehicles with compression-ignition engines.

3.1.2. Test instrumentation

The vacuum (or absolute pressure) in the vehicle's intake manifold shall be measured to an accuracy of +/- 0.25 kPa. It shall be possible to record this reading continuously or at intervals of no more than one second. The speed shall be recorded continuously with a precision of +/- 0.4 km/h.

3.1.3. Road test

3.1.3.1. Ensure that the requirements of paragraph 4. of Appendix 3 to this annex are met.

3.1.3.2. Drive the vehicle at a steady speed of 80 km/h, recording speed and vacuum (or absolute pressure) in accordance with the requirements of paragraph 3.1.2. above.

3.1.3.3. Repeat procedure set out in paragraph 3.1.3.2. above three times in each direction. All six runs must be completed within four hours.

3.1.4. Data reduction and acceptance criteria

3.1.4.1. Review results obtained in accordance with paragraphs 3.1.3.2. and 3.1.3.3. above. (Speed must not be lower than 79.5 km/h or greater than 80.5 km/h for more than one second). For each run, read vacuum level at one second intervals, calculate mean vacuum and standard deviation (s). This calculation shall consist of no less than 10 readings of vacuum.

3.1.4.2. The standard deviation must not exceed 10 per cent of the mean (v) for each run.

3.1.4.3. Calculate the mean value for the six runs (three runs in each direction).

3.1.5. Dynamometer setting

3.1.5.1. Preparation

Perform the operations specified in paragraphs 5.1.2.2.1. to 5.1.2.2.4. of Appendix 3 to this annex.

3.1.5.2. Load setting

After warm-up, drive the vehicle at a steady speed of 80 km/h and adjust dynamometer load to reproduce the vacuum reading (v) obtained in accordance with paragraph 3.1.4.3. above. Deviation from this reading shall be no greater than 0.25 kPa. The same instruments shall be used for this exercise as were used during the road test.

3.2. Alternative method

With the manufacturer's agreement the following method may be used.

3.2.1. The brake is adjusted so as to absorb the load exerted at the driving wheels at a constant speed of 80 km/h, in accordance with the following table:

3.2.2. In the case of vehicles other than passenger cars, with a reference mass of more than 1,700 kg or vehicles with permanent all-wheel drive, the power values given in the table set out in paragraph 3.2.1. above are multiplied by the factor 1.3.

Annex 4 Appendix 2

Reference mass of vehicle Rm (kg)	Equivalent inertia kg	Power and load absorbed by the dynamometer at 80 km/h		Coefficients	
		kW	N	a N	b N/(km/h)
Rm ≤ 480	455	3.8	171	3.8	0.0261
480 < Rm ≤ 540	510	4.1	185	4.2	0.0282
540 < Rm ≤ 595	570	4.3	194	4.4	0.0296
595 < Rm ≤ 650	625	4.5	203	4.6	0.0309
650 < Rm ≤ 710	680	4.7	212	4.8	0.0323
710 < Rm ≤ 765	740	4.9	221	5.0	0.0337
765 < Rm ≤ 850	800	5.1	230	5.2	0.0351
850 < Rm ≤ 965	910	5.6	252	5.7	0.0385
965 < Rm ≤ 1,080	1,020	6.0	270	6.1	0.0412
1,080 < Rm ≤ 1,190	1,130	6.3	284	6.4	0.0433
1,190 < Rm ≤ 1,305	1,250	6.7	302	6.8	0.0460
1,305 < Rm ≤ 1,420	1,360	7.0	315	7.1	0.0481
1,420 < Rm ≤ 1,530	1,470	7.3	329	7.4	0.0502
1,530 < Rm ≤ 1,640	1,590	7.5	338	7.6	0.0515
1,640 < Rm ≤ 1,760	1,700	7.8	351	7.9	0.0536
1,760 < Rm ≤ 1,870	1,810	8.1	365	8.2	0.0557
1,870 < Rm ≤ 1,980	1,930	8.4	378	8.5	0.0577
1,980 < Rm ≤ 2,100	2,040	8.6	387	8.7	0.0591
2,100 < Rm ≤ 2,210	2,150	8.8	396	8.9	0.0605
2,210 < Rm ≤ 2,380	2,270	9.0	405	9.1	0.0619
2,380 < Rm ≤ 2,610	2,270	9.4	423	9.5	0.0646
2,610 < Rm	2,270	9.8	441	9.9	0.0674

Thank you!