Chapter 3

TYPE I TEST ON S.I. ENGINES, CNG, LPG AND DIESEL ENGINED VEHICLE (VERIFYING THE AVERAGE TAILPIPE EMISSION) OF GASEOUS AND PARTICULATE POLLUTANTS

1. This chapter describes the procedure for the Type I test defined in paragraph 5.2.2 of Chapter 1 of this Part. This chapter should be read in conjunction with applicable Gazette Notification under CMVR for which the test is to be carried out.

2. Operating Cycle on the Chassis Dynamometer :

2.1 Description of the Cycle : The operating cycle on the chassis dynamometer shall be as given in 2.1.1 and 2.1.2 as applicable.

2.1.1 The operating cycle on the chassis dynamometer for all two and three wheelers shall be that indicated in Table I and depicted in Figure 2 of this Chapter. The breakdown by operations is given in Table II of this Chapter

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 approximately to the theoretical cycle within the prescribed limits.

2.2.1 Use of the Gear Box : The use of the gearbox in case of testing two and three wheelers on chassis dynamometer shall be in accordance with Para 2.2.2 of this Chapter.

2.2.2 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. Use of the Gear Box for two and three wheelers : The use of the gear box shall be as specified by the manufacturer. However, in the absence of such instructions, the following points shall be taken into account.:

2.2.2.1 Manual Change Gear Box :

2.2.2.1.1 During each phase at constant speed, the rotating speed of the engine shall be, if possible, between 50 and 90% of the speed corresponding to the maximum power of the engine. When this speed can be reached in two or more gears, the vehicle shall be tested with the higher gear engaged.

2.2.2.1.2 During acceleration, the vehicle shall be tested in whichever gear is appropriate to the acceleration imposed by the cycle. A higher gear shall be engaged at the latest when the rotating speed is equal to 110% of the speed corresponding to the maximum power of the engine.

2.2.2.1.3 During deceleration, a lower gear shall be engaged before the engine starts to idle roughly, at the latest when the engine revolutions are equal to 30% of the speed corresponding to the maximum power of the engine. No change down to first gear shall be effected during deceleration.

2.2.2.1.4 Vehicles equipped with an overdrive which the driver can actuate shall be tested with the overdrive out of action.

2.2.2.1.5 When it is not possible to adhere to the cycle, the operating cycle will be modified for gear change points, allowing 2 seconds time interval at constant speed for each gear

change keeping the total time constant. Figure 1 of this chapter shows the operating cycle with recommended gear positions.

2.2.2.2 Automatic Gear Box : Vehicles equipped with automatic shift gear boxes 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.

2.3 **Tolerances**

2.3.1 A tolerance of ± 1 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, then the timing of the theoretical cycle shall be restored by constant speed or idling period merging into the following operation. Speed tolerances greater than those prescribed shall be accepted, during phase changes provided that the tolerances are never exceeded for more than 0.5 second on any one occasion.

2.3.2 Time tolerances of ± 0.5 second shall be allowed. The above tolerances shall apply equally at the beginning and at the end of each gear changing period.

2.3.3 The speed and time tolerances shall be combined as indicated in Figure 2 of this chapter.

3 Vehicle and Fuel

3.1 Test Vehicle :

3.1.1 The vehicle presented shall be checked that it is the same model as specified as per format of chapter 2 of this Part. It shall have been run-in either as per manufacturer's specification or at least 250 kms before the test.

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

3.1.3 The air intake system should be leak proof.

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 and for the cold start device, automatic choke, and exhaust gas cleaning systems, etc.The vehicle to be tested, or an equivalent vehicle, shall be fitted, if necessary with a device to permit the measurement of characteristic parameters necessary for the chassis dynamometer setting.

3.1.5 The testing agency may verify that the vehicle conforms to the performance of power, acceleration, maximum speed etc., stated by the manufacturer and 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 :** The reference fuel as prescribed in the applicable Gazette notification shall be used. If the engine is lubricated by a fuel oil mixture, the oil added to reference fuel shall comply as to grade and quantity with the manufacturer's recommendation. Until availability of reference LPG (Fuel A & Fuel B), CNG (G20, G25) as per Notification, CNG, LPG vehicles will be tested as per commercially available CNG/LPG fuels as per guidelines given GOI.

4 Test Equipment :

4.1 Chassis Dynamometer :

4.1.1 The dynamometer must be capable of simulating road load 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 chassis dynamometer may have one or two rollers. In the case of a single roller, the roller diameter shall not be less than 400 mm for 2 & 3 wheelers.

4.1.3 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.

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

4.1.5 The roller shall be fitted with a revolution counter with reset facility to measure the distance actually covered.

4.1.6 **Accuracy :**

4.1.6.1 It shall be possible to measure and read the indicated load to an accuracy of ±5 percent.

4.1.6.2 In the case of a dynamometer with an adjustable load curve, the accuracy of matching dynamometer load to road load shall be within 5 per cent at 50, 40, 30 km/h and 10 percent at 20 km/h. Below this, the dynamometer absorption must be positive.

4.1.6.3 The total equivalent inertia of the rotating parts (including the simulated inertia where applicable) must be known and within ± 20 kg of the inertia class for the test, in case of 3 -wheeler vehicles; for 2-wheeler vehicles within ± 2 per cent."

4.1.6.4 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.

4.1.7 **Load and Inertia Setting :**

4.1.7.1 Dynamometer with adjustable load curve: the load simulator shall be adjusted in order to absorb the power exerted on the driving wheels at various steady speeds of 50, 40, 30 and 20 km/h.

4.1.7.2 The means by which these loads are determined and set are described in Chapter 4 of this Part.

4.1.7.3 Chassis Dynamometers with electrical inertia simulation must be demonstrated to be equivalent to mechanical inertia systems. The means by which equivalence is established is described in Chapter 5 of this Part.

4.1.8 **Chassis Dynamometer Calibration :**

4.1.8.1 The dynamometer should be calibrated periodically as recommended by the manufacturer of the chassis dynamometer and then calibrated as required. The calibration shall consist of the manufacturers' recommended procedure and a determination of the dynamometer frictional power absorption at 40 km/h when being

used for testing of two and three wheelers. One method for determining this is given in Chapter 7. Other methods may be used if they are proven to yield equivalent results.

4.1.8.2 The performance check consists of conducting dynamometer coast down time at one or more inertia power setting and comparing the coast down time to that recorded during the last calibration. If the coast down time differs by more than 1 second, a new calibration is required.

4.2 Exhaust Gas-sampling System :

4.2.1 The exhaust gas-sampling shall be designed to enable the measurement of the true mass emissions of vehicle exhaust. A Constant Volume Sampler System (CVS) wherein the vehicle exhaust is continuously diluted with ambient air under controlled conditions should be used. In the constant volume sampler concept of measuring mass emissions, two conditions must be satisfied -the total volume of the mixture of exhaust and dilution air must be measured and a continuously proportional sample of the volume must be collected for analysis. Mass emissions are determined from the sample concentrations, corrected for the pollutant content of the ambient air and totalized 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 4.3.2.

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 Chapter 6 of this part.

4.2.3 Figure 5, 6, and 7 of Chapter 6 of this Part gives a schematic diagram of the general concept. Examples of three types of Constant Volume Sampler systems which will meet the requirements are given in Chapter 6 of this part.

4.2.4 The gas and air mixture shall be homogenous 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 should 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, then 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 connection tubes shall be connected as near as possible to the vehicle.

4.2.8 Static pressure variations at the tail pipe(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 tailpipe(s). Sampling systems capable of maintaining the static pressure to within ± 0.25 kPa will be used if a written request from a manufacturer to the authority 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 shall be 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% after twenty minutes of storage.

4.3 Analytical Equipment :

4.3.1 Pollutant gases shall be analysed with the following instruments :

4.3.1.1 Carbon monoxide (CO) and carbon dioxide (CO_2) analysis. The carbon monoxide and carbon dioxide analysers shall be of the Non-Dispersive Infra Red (NDIR) absorption type.

4.3.1.2 Hydrocarbon (HC) analysis - Gasoline Vehicles. The hydrocarbons analyser shall be of the Flame Ionisation (FID) type calibrated with propane gas expressed equivalent to carton atoms.

4.3.1.3 Hydrocarbons (HC) analysis - Diesel Vehicles. The hydrocarbon analyser shall be of the Flame Ionisation type Detector with valves , pipe work etc. heated to 463 K ± 10 K (HFID). It shall be calibrated with propane gas expressed equivalent to carbon atoms (C1).

4.3.1.4 Nitrogen oxide (NOx) analysis. The nitrogen oxide analyser shall be of the Chemiluminescent (CLA) type with an NOx-NO converter or by NDUVR (non- dispersive ultraviolet resonance absorption) type analyser.

4.3.1.5 Particulates : Gravimetric determination of the particulates collected. These particulates are in each case 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 :

V_{ep} : Flow through filters.
V_{mix} : Flow through tunnel.
M : Particulate mass (g/km)
M_{limit}: Limit mass of particulates (limit mass in force, g/km)
m : Mass of particulates collected by filters (g)
d : Actual distance corresponding to the operating cycle (km)

$$M = \frac{(V_{mix} * m)}{(V_{ep} * d)}$$ or

$$m = \frac{(M * d * V_{ep})}{V_{mix}}$$

$$M = \frac{V_{mix}}{V_{ep}} * \frac{m}{d}$$

The particulate sample rate (V_{ep} / V_{mix}) will be adjusted so that for $M = M_{limit}$ $1 \leq m \leq 5$ mg (when 47mm diameter filters are used).

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

4.3.1.6 Accuracy

The analysers must have a measuring range compatible with the accuracy required to measure the concentrations of the exhaust gas sample pollutants. Measurements error must not exceed ± 2% (intrinsic error of analyser) disregarding the true value for the calibration gases. For concentration of less than 100 ppm the measurement error must not exceed ±2 ppm.The ambient air sample must be measured on the same analyser with an appropriate range.

The microgram balance used to determine the weight of all filters must have an accuracy of 5 ug and readability of 1 ug.

4.3.1.7 Ice-trap No gas drying device shall be used before the analysis unless it is shown that it has no effect on the pollutant content of the gas stream.

4.3.2 Particular requirements for compression ignition engines :

4.3.2.1 A heated sample line for a continuous HC-analysis with the heated flame ionisation detector (HFID), including recorder (R) is to be used.

4.3.2.2 The average concentration of the measured hydrocarbons shall be determined byintegration. Throughout the test, the temperature of the heated sample line shall be controlled at 463 K (190°C)±10 K. The heated sampling line shall be fitted with a heated filter (Fh) 99% efficient with particle ≥ 0.3 µm to extract any solid particles from the continuous flow of gas required for analysis.

4.3.2.3 The sampling system response time (from the probe to the analyser inlet) shall be no more than 4s.

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

4.3.2.4 The particulate sampling unit consist of a dilution tunnel, a sampling probe, a filter unit, a partial flow pump, and a flow rate regulator and measuring unit. 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 homogenous air / exhaust mixture and an air / exhaust gas mixture temperature of 325 K (52°C) shall not exceed immediately before the particulate filter. The temperature of the gas flow in the flow meter shall not fluctuate more than ± 3K, nor the mass flow rate shall fluctuate more than ± 5%. If the volume of flow change unexpectedly as a result of excessive filter loading, the test should be stopped. When it is repeated, the rate of flow shall be decreased and / or larger filter shall be used. The filters shall be removed from the chamber not earlier than an hour before the test begins.

4.3.2.5 The necessary particulate filters should be conditioned (as regards temperature and humidity) in an open dish which shall be protected against dust ingress for at least 8 and not more than 56 hours before the test in an air conditioned chamber After this conditioning, the uncontaminated filters shall be read and stored until they are used.

The temperature of the chamber (or room) in which particulate filters are conditioned and weighted shall be maintained to within 295 +/-3°K(22°C +/-3°C) during all filter

conditioning and weighing. The humidity shall be maintained to a dew point of 282-3 °K +/-3°K (9.5°C +/- 3°C) and a relative humidity of 45%+/-8%.

4.3.2.6 If the filters are not used within 1 hour of their removal from the weighing chamber then they shall be re-weighed. The one hour limit shall be replaced by an eight hour limit if one or both of the following conditions are met:

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

A stabilized 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 :**

4.3.3.1 Each analyzer 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.

4.3.3.2 The calibration method that shall be used is described in Chapter 7 of this part for the analyzers indicated in para 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 within ± 2 per cent.

4.4.2 **Constant Volume Sampler Calibration :**

4.4.2.1 The Constant Volume Sampler system volume measurement device shall be Calibrated by a suitable method to ensure the prescribed accuracy and at a Frequency sufficient to maintain such accuracy.

4.4.2.2 An example of a calibration procedure which will give the required accuracy is given in Chapter 7 of this part. The method shall utilize a flow-metering device Which is dynamic and suitable for the high flow rate encountered in Constant Volume Sampler testing. The devices 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 when necessary, for calibration and operation:

- Purified nitrogen (purity ≤ 1 ppm C, ≤ 1ppm CO, ≤ 400 ppm CO2, ≤ 0.1 ppm NO);
- Purified synthetic air (purity ≤ 1 ppm C, ≤ 1ppm CO, ≤ 400 ppm CO2, ≤ 0.1 ppm NO); oxygen content between 18% & 21% vol.;
- Purified oxygen (purity ≤ 99.5 per cent Vol O2);

- Purified hydrogen (and mixture containing hydrogen) (Purity ≤ 1ppm C, ≤ 400 ppm CO2).

4.5.2 **Calibration and span gases :**

Gases having the following chemical compositions shall be available of:
-C3 H8 and purified synthetic air, as in para 4.5.1 above

-CO and purified nitrogen, as in para 4.5.1 above
-CO_2 and purified nitrogen, as in para 4.5.1 above
-NO and purified nitrogen, as in para 4.5.1 above (The amount of NO2 contained in this calibration gas must not exceed 5 percent of the NO content)

4.5.3 The true concentration of a calibration gas shall be within ± 2% of the stated figure.

4.5.4 The concentrations specified in Chapter 7 of this part may also be obtained by means of a gas divider, diluting with purified nitrogen or with purified synthetic air. The accuracy of the mixing device shall be such that the concentrations of the diluted calibration gases may be determined within ±2%.

4.6 Additional equipment :

4.6.1 Temperatures : The temperature indicated in Chapter 8 of this part shall be measured with an accuracy of ± 1.5 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 %.

4.7 The exhaust gas-sampling system shall be verified by the method described in para 3 of Chapter 7 of this part. The maximum permissible deviation between the quantity of gas introduced and the quantity of gas measured shall be 5 %.

5 Preparations for 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 weight within the following limits given in Table III.

5.2 Setting of dynamometer :

5.2.1 The load shall be adjusted according to methods described in paragraph 4.1.7 above.

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

TABLE I
OPERATING CYCLE ON THE CHASSIS DYNAMOMETER (Please ref. Para. 2.1.1)

No. of operation		Acceleration 2 (m/sec)	Speed (Km/h)	Duration of each operation (S)	Cumulative time(s)
01.	Idling	--	—	16	16
02.	Acceleration	0.65	0-14	6	22
03.	Acceleration	0.56	14-22	4	26
04.	Deceleration	-0.63	22-13	4	30
05.	Steady speed	-	13	2	32
06.	Acceleration	0.56	13-23	5	37
07.	Acceleration	0.44	23-31	5	42
08.	Deceleration	-0.56	31-25	3	45
09.	Steady speed	-	25	4	49
10.	Deceleration	-0.56	25-21	2	51
11.	Acceleration	0.45	21-34	8	59
12.	Acceleration	0.32	34-42	7	66
13.	Deceleration	-0.46	42-37	3	69
14.	Steady speed	-	37	7	76
15.	Deceleration	-0.42	37-34	2	78
16.	Acceleration	0.32	34-42	7	85
17.	Deceleration	-0.46	42-27	9	94
18.	Deceleration	-0.52	27-14	7	101
19.	Deceleration	-0.56	14-00	7	108

BREAK DOWN OF THE OPERATING CYCLE USED FOR THE TYPE I TEST (Please ref. para. 2.1.1)

TABLE II

A: BREAK DOWN BY PHASES

Sr. No.	Particulars	Time(s)	Percentage
1	Idling	1-6	14.81
2	Steady speed periods	13	12.04
3	Accelerations	42	38.89
4	Deceleration's	37	34.26
		108	100

B : AVERAGE SPEED DURING TEST : 21.93 Km/h
C ; THEORETICAL DISTANCE COVERED PER CYCLE : 0.658 Km.
D ;. EQUIVALENT DISTANCE FOR THE TEST (6 cycles) : 3.948 Km.

Table III

For 2 and 3 wheelers		
Reference Mass of Vehicle RW (kg)		Equivalent Inertia (kg.)
Exceeding	Upto	
	105	100
105	115	110
115	125	120
125	135	130
135	150	140
150	165	150
165	185	170
185	205	190
205	225	210
225	245	230
245	270	260
270	300	280
300	330	310
330	360	340
360	395	380
395	435	410
435	480	450

480	540	510
540	600	570
600	650	620
650	710	680
710	770	740
770	820	800
820	880	850
880	940	910
940	990	960
990	1050	1020
1050	1110	1080
1110	1160	1130
1160	1220	1190
1220	1280	1250
1280	1330	1300
1330	1390	1360
1390	1450	1420
1450	1500	1470
1500	1560	1530
1560	1620	1590
1620	1670	1640
1670	1730	1700
1730	1790	1760

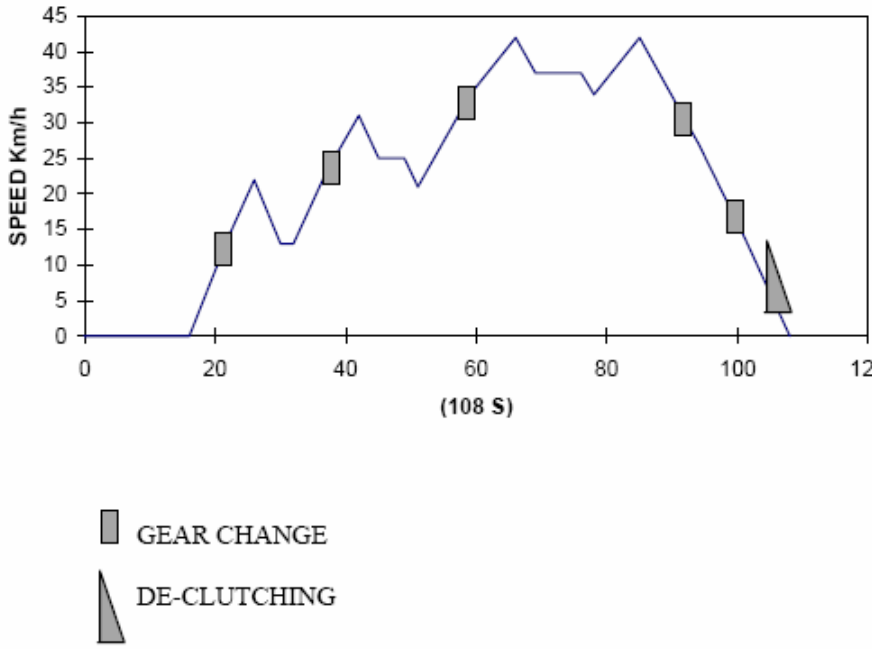
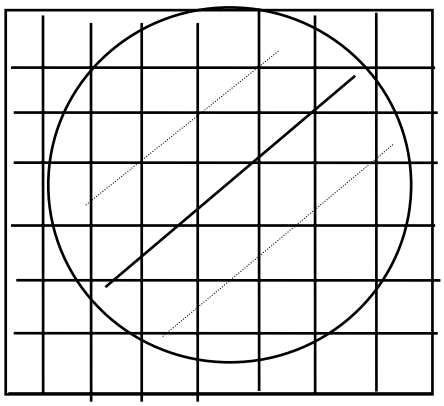


Fig 1 : OPERATING CYCLE WITH RECOMMENDED GEAR POSITION
(Pl. ref. para 2.3.1.1.5)



SPEED AND TIME TOLERANCES

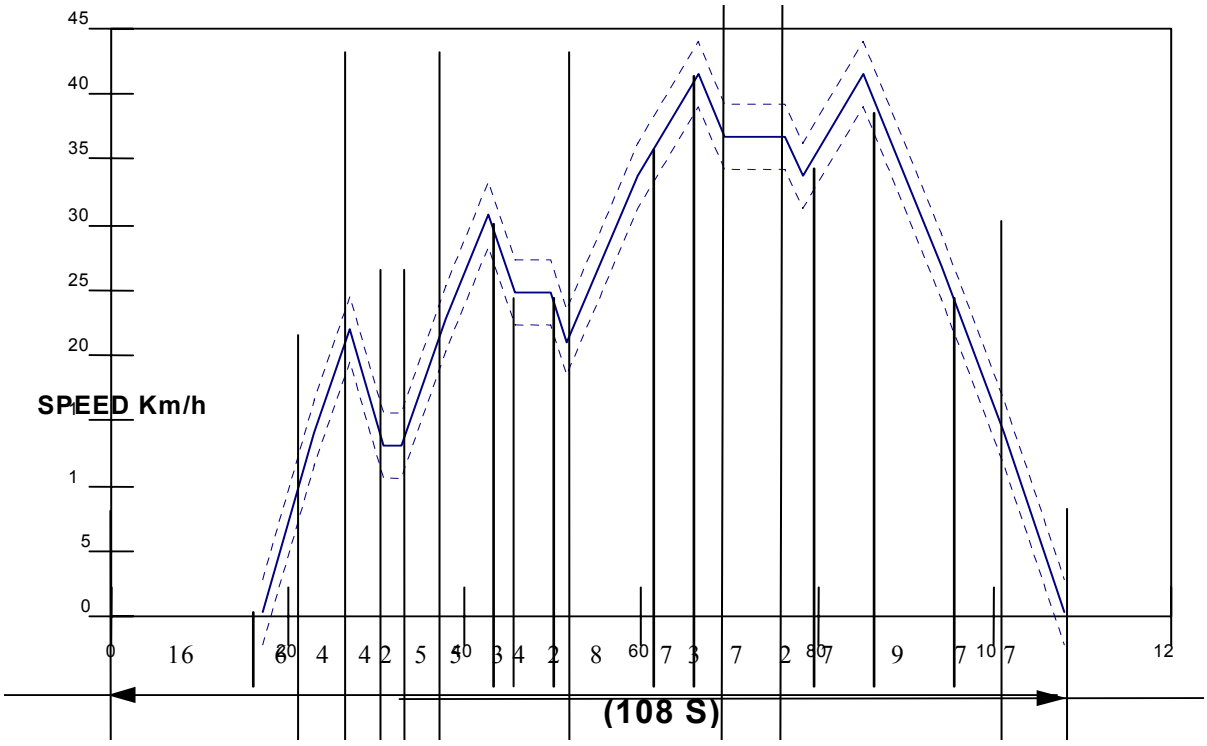


Fig 2: Operating cycle with speed and time tolerances
(Pl. ref. para 2.1.1)

5.3 Preconditioning of the vehicle :

5.3.1 For the compression ignition engine vehicles for the purpose of measuring particulates at most 36 hours and at least 6 hours before testing, Table 1 for 3 wheeler vehicles shall be used. 6 consecutive cycles for 3 wheelers shall be driven. The dynamometer setting shall be as per 5.1 and 5.2 above

5.3.2 After this preconditioning specific for compression ignition engines and before testing, compression ignition and positive ignition engine vehicles shall be kept in a room in which a temperature remains relatively constant between 293 K and 303 K (20 and 30°C). The vehicle soaking shall be carried out for at least 6 hours and continue until the engine oil temperature, or coolant temp, or in case or in case of air cooled engines spark plug/gasket temp, equal to the +/- 2K of the air temp, of soak area room.

5.3.3 Soaking period will be from 6 to 30 hours.

5.3.4 The tyre pressure shall be the same as that indicated by the manufacturer and used for the preliminary road test for data collection for adjustment of chassis Dynamometer. The tyre pressure may be increased by up to 50 per cent from the manufacturer's recommended setting in the case of a two roll dynamometer. The actual pressure used shall be recorded in the test report.

6 Procedure for Chassis Dynamometer Test :

6.1 Special conditions for carrying out the cycle :

6.1.1 During the test, the test cell temperature shall be between 293 K and 303 K (20 and 30°C). The absolute humidity (H) of either the air in the test cell or the intake air of the engine shall be such that: $5.5 \leq H \leq 12.2$ gH_2O/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 During the test, the speed can be recorded against time so that the correctness of the cycle performed can be assessed.

6.1.4 **Cooling of the Vehicle :**

6.1.4.1 The blower speed shall be such that, within the operating range of 10 km/h to at least up to 50 km/h the linear velocity of the air at the blower outlet is within ± 5 km/h of the corresponding roller speed. At roller speeds of less than 10 km/h, air velocity may be zero, the blower outlet shall have a cross section area of at least 0.4 m2 and the bottom of the blower outlet shall be between 15 and 20 cm above floor level. The distance from front end of the vehicle is appox. 30 cm to 45 cm.

6.1.4.2 The device used to measure the linear velocity of the air shall be located in the middle of the stream at 20 cm away from the air outlet. The air velocity shall be 25 km/h ± 5 km/h. This velocity shall be as nearly constant as possible across the whole of the blower outlet surface. At the request of the manufacturer for special vehicles (e.g Van, Off road) the height of the cooling fan can be modified.

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 driver's handbook of production vehicles.

6.2.2 The cold start procedure for two and three wheeler diesel and all other vehicles to be followed shall be in accordance with 6.2.2.1 & 6.2.2.2

6.2.2.1 All two and three wheeler vehicles shall be run with 40 seconds idling and 4 cycles as per 2.1.1 of this Chapter as preparatory running before sampling on chassis dynamometer. Diesel two and three wheelers shall be run with 40 seconds idling before sampling on chassis dynamometer.

6.2.2.2 The engine shall be kept idling for 40 seconds, in the case of two and three wheelers. During the idling phase, the operator may use choke, throttling etc., where necessary to keep the engine running. In the case of two and three wheelers with spark ignition engine, immediately after the end of the 40 seconds of idling period the number of complete preparatory cycles specified in para 6.2.2.1 are affected without collecting exhaust gases. The test cycle shall begin immediately after this.

6.2.2.3 If during the start, the vehicle does not start after 10 seconds of cranking, or ten operations of manual starting mechanism, cranking shall cease and the reason for failure to start shall be determined.

6.2.2.4 The corrective action for this, including those caused by the vehicle malfunction, if it is of less than 30 minutes duration, may be taken and test continued. If the failure to start is caused by vehicle malfunction and the vehicle can not be started, the test shall be cancelled, the vehicle removed from the dynamometer, corrective action taken and the vehicle rescheduled for test (Refer para 5.3.3 above). The reason for malfunction (if determined) and the corrective action taken shall be reported.

6.2.2.5 If the engine stalls during 40 seconds of idling and where applicable during the preparatory cycles, the engine shall be restarted immediately and test continued. If the vehicle does not restart within a minute, the test shall be cancelled, the vehicle rescheduled for the test (refer para 5.3.3 above). The reason for malfunction, (if determined) and the corrective action taken shall be reported.

6.2.2.6 If the engine stalls during some operating mode other than idle/preparatory cycles, the driving schedule indicator and gas sampling shall be stopped, the vehicle shall then be restarted and accelerated to the speed required at the point in driving schedule and the test and the gas sampling continued. During the acceleration upto this point, gear shifting shall be performed as per para 2.3 of this chapter.

6.2.2.7 If the vehicle does not restart within one minute, the test shall be canceled, the vehicle removed from the dynamometer, corrective action taken, and the vehicle rescheduled for test (refer para 5.3.3 above).

6.2.2.8 The reason for the malfunction (if determined) and the corrective action taken shall be indicated in the test report.

6.2.2.9 During corrective action referred to the paragraphs 6.2.2.4, 6.2.2.5 and 6.2.2.8 above, adjustments and setting only within the limits specified by the manufacturer shall be permitted. Changes outside the limits specified shall be governed by the applicable procedure given in Part VI.

6.2.3 If the maximum speed of the vehicle is less than the maximum speed of the driving cycle, that part of the driving cycle, where speed is exceeding the vehicle's maximum speed, the vehicle will be driven with the accelerator control fully actuated

6.3 Idling :

6.3.1 Manual-shift or semi-automatic gear-box :

6.3.1.1 During periods of idling, the clutch shall be engaged and gears in neutral.

6.3.1.2 To enable the accelerations to be performed according to normal cycle the vehicle shall be placed in first gear, with clutch disengaged, 5 seconds before the Acceleration following the idling period considered of the IDC for 2&3 wheelers.

6.3.1.3 For 2 & 3 wheelers the first idling period at the beginning of the cycle shall consist of 11 seconds of idling in neutral with the clutch engaged and 5 seconds in first gear with the clutch disengaged.

6.3.2 Automatic-shift gear-box: After initial engagement, the selector shall not be operated at any time during the test except in accordance with paragraph 6.4.3 below.

6.4 Accelerations :

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

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

6.4.3 Automatic-shift gear-boxes : If an acceleration cannot be carried out in the prescribed time the gear selector shall be operated in accordance with requirements for manual-shift gear-boxes.

6.5 Decelerations :

6.5.1 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 abided by.

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

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 :

7.1.1 Sampling for all two and three wheelers except diesel vehicles shall begin at the end of fourth preparatory cycle and shall complete at the end of tenth cycle as defined in para

2.1.1 of this Chapter In the case of diesel three wheelers the sampling shall begin at the end of 40 seconds of idling after initiation of the engine start up.

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 must be taken to the chamber no later than 1 hour after conclusion of the test on the exhaust gases and must be conditioned for between 2 & 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 percent of the range.

7.2.4 The analysers' zeros shall then be re-checked. If the reading differs by more than 2 percent of 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 re-checked using the same gases. If these re-checks are within 2 percent of those in paragraph 7.2.3, then the analysis shall be considered acceptable.

7.2.7 For all the points in this section, the flow rates and pressure of the various gases must 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. Diesel hydrocarbon mass emissions shall be calculated from the integrated HFID reading corrected for varying flow, if necessary as shown in Chapter 6 of this part.

8 Determination of the Quantity of Gaseous Pollutants Emitted :

8.1 The volume considered : The volume to be considered shall be corrected to conform to the conditions of 101.3 kPa and 293 K.

8.2 Total Mass of Gaseous Pollutants Emitted : The mass, M, of each pollutant emitted by the vehicle during the test shall be determined by obtaining the product of the voluminal concentration and the volume of the gas in question, with due regard for the following densities at the above mentioned reference condition.

- - in the case of carbon monoxide (CO): d = 1.164 kg/m^3
- in the case of hydrocarbons ($CH_{1.85}$):
  - for petrol ($CH_{1.85}$) d = 0.5768 Kg/ m^3
  - for diesel ($CH_{1.86}$) d = 0.5768 Kg/ m^3
  - for LPG ($CH_{2.525}$) d = 0.6047 Kg/ m^3
  - for CNG (CH_4) d = 0.665 Kg/ m^3
- in the case of nitrogen oxides (NO_x): d = 1.913 kg/ m^3.
- in the case of Carbon Dioxides (CO_2): d = 1.830 kg/ m^3.

The mass ‘m’ of particulate pollutant emissions from the vehicle during the test is defined by weighing the mass of particulates collected by two filters, ‘m1‘ by the first filter, ‘m2‘ by the second filter.

- if $0.95 (m1 + m2) \leq m1$, $m = m1$,
- if $0.95 (m1 + m2) > m1$, $m = m1 + m2$,
- if $m2 > m1$, the test shall be cancelled.

8.3 Chapter 8 of this Part describes the calculations, followed by examples, used in determining the mass emissions of gaseous and particulates.