

MoRTH/CMVR/ TAP-115/116	STANDARDS AND TEST PROCEDURES FOR FREE ACCELERATION	
ISSUE NO. 4		PART II

PART II : DETAILS OF STANDARDS AND TEST PROCEDURES FOR MEASUREMENT OF SMOKE LEVELS BY FREE ACCELERATION FOR IN-SERVICE VEHICLES FITTED WITH DIESEL ENGINES

1. Scope and Field of Application

- 1.1 This part applies to the emissions of visible pollutants from in-service compression ignition (diesel) engine vehicles, when subjected to a free acceleration test as referred in CMVR-115 (2)(b) and for issue of "Pollution under control certificate" to be issued by the authorised agencies under CMVR-115 (7).
- 1.2 This part specifies standard and test procedure for the determination of smoke levels by free acceleration from road vehicles equipped with compression ignition engines.

2. Definitions

- 2.1 Compression Ignition Engine: means an Internal Combustion Engine that operates on compression ignition principle (Diesel Engines).
- 2.2 Smoke Density: means the light absorption coefficient of the exhaust gases emitted by the vehicle expressed in terms of m^{-1} or in other units such as Bosch, Hartidge, % opacity etc.
- 2.3 Opacity Meter: means an Instrument for continuous measurement of the light absorption coefficient of the exhaust gases emitted by vehicles.
- 2.4 Maximum Rated Speed: means the maximum speed permitted by governor at full load.
- 2.5 Free Acceleration Test: means the test conducted by abruptly but not violently, accelerating the vehicle from idle to full speed with the vehicle stationary in neutral gear.

3.0 Test Procedure

3.1 Test Instrument

- 3.1.1 The opacimeter, the Instrument used for the measurement of smoke should be a type approved instrument as given in CMVR -116(3) and meeting the requirements specified in Part-VIII.
- 3.1.2 The Instrument should be prepared, used and maintained following the directions given in the instrument manufacturer's operation manual and it should be serviced and calibrated at such intervals as to ensure accuracy.
- 3.2 Sampling Opacimeter
 - 3.2.1 Installation for tests under Free Acceleration
 - 3.2.1.1 The ratio of cross sectional area of the probe to that of the exhaust pipe shall not be less than 0.05.
 - 3.2.1.2 The probe shall be a tube with an open end facing forward in the axis of exhaust pipe or of the extension pipe, if one is required. It shall be situated in a section where the distribution of smoke is approximately uniform. To achieve this, the probe shall be placed as far downstream in the exhaust pipe as possible or if necessary in an extension pipe so that, if D is the diameter of exhaust pipe at the opening, the end of probe is situated in a straight portion at least 6 D in length upstream of the sampling point and 3 D in length downstream. If an extension pipe is used, no air shall be allowed to enter the joint.
 - 3.2.1.3 The sampling system shall be such that at all engine speeds, pressure of the sample at the opacimeter is within the limits specified. This may be checked by noting the sample pressure at engine idling and maximum no load speeds. Depending on the characteristics of the opacimeter, control of sample pressure can be achieved by a fixed restriction or butterfly valve in the exhaust pipe or extension pipe. Whichever method is used, the backpressure measured in the exhaust pipe at the opening of the probe shall not exceed 75 mm (water gauge).
 - 3.2.1.3 The pipes connecting the opacimeter shall also be as short as possible. The pipe shall be inclined upwards from the sampling point to the opacimeter and sharp bends where soot might accumulate shall be avoided. A bypass valve may be provided upstream of opacimeter to isolate it from the exhaust gas flow when no measurement is being made.
 - 3.2.1.4 The temperature probe for the measurement of oil temperature shall be inserted in place of oil dipstick.
 - 3.2.1.5 The engine speed measurement sensor shall be appropriately installed on to the engine of the vehicle.
 - 3.3 Full Flow Opacimeter

The only general precautions to be observed in free acceleration tests are the following:

3.3.1 Joints in the connecting pipes, if any, between the exhaust pipe and the opacimeter shall not allow air to enter from outside.

3.3.1.2 The pipes connecting the opacimeter shall be as short as possible, as prescribed in the case of sampling opacimeter. The pipe system shall be inclined upwards from the exhaust pipe to the opacimeter, and sharp bends where soot might accumulate shall be avoided. A by-pass valve may be provided upstream of the opacimeter to isolate it from the exhaust gas flow when no measurement is being made.

3.3.3 A cooling system may also be required upstream of the opacimeter.

3.4 Vehicle Inspection

3.4.1 The Exhaust device shall not have any orifice through which the gases emitted by the engine might be diluted.

3.4.2 In cases where an engine has several exhaust outlets; these shall be connected to a single outlet in which opacity measurement shall be made. If it is not possible, to combine all exhaust outlets in one, the smoke shall be measured in each and an arithmetical mean of the values shall be recorded at each outlet. The test shall be taken as valid only if the extreme values measured do not differ by more than 0.15m^{-1}

4.4.3 The engine shall be in normal working condition prescribed by the manufacturer.

4.5 Measurement Procedure

4.5.1 Free Acceleration Test

4.5.1.1 The test shall be carried out on a vehicle.

4.5.1.2 The engine of the vehicle shall be warmed-up to attain oil temperature of $60\text{ }^{\circ}\text{C}$. The test shall be carried out as soon as this engine condition is reached.

4.5.1.3 The combustion chamber shall not have been cooled or fouled by a prolonged period of idling preceding the test.

4.5.1.4 The vehicle gear change control shall be set in the neutral position and the drive between engine and gearbox engaged. With the engine idling, the accelerator control shall be operated quickly, but not violently, so as to obtain maximum delivery from the injection pump. This position shall be maintained until maximum engine speed is reached and the governor comes into action. As soon as this speed is reached the accelerator shall be

released until the engine resumes its idling speed and the opacimeter reverts to the corresponding conditions. Typically the maximum time for acceleration shall be 5s and for the stabilization at maximum no load speed shall be 2s. The time duration between the two free accelerations shall be between 5-20s.

4.5.1.5 The operation described in 4.5.1.4 above shall be repeated not less than six times in order to clear the exhaust system and to allow for any necessary adjustments of the apparatus. During this operation the sample probe shall not be inserted in to the vehicle exhaust system.

4.5.1.6 The free acceleration smoke test as per operation in 4.5.1.4 shall be carried out with sample probe inserted in to the vehicle exhaust system. The maximum no load rpm reached during this operation shall be within ± 500 rpm in respect of 3 wheeler vehicles and ± 300 rpm for all other categories of vehicles, of the average value obtained in the last four of the six flushing cycles in 4.5.1.5. If for any reason the speed is not within the specified tolerance band the particular smoke reading shall be considered as invalid and shall be discarded. The above operation shall be repeated till the peak smoke values recorded in four successive accelerations are valid and are situated within a bandwidth of 25 % of the arithmetic mean (in m-1 unit) of these values or within a bandwidth of 0.25 K, whichever is higher and do not form a decreasing sequence.

The absorption coefficient to be recorded shall be the arithmetic mean of these four valid readings. The vehicle should be considered meeting the requirement if the absorption coefficient thus recorded is less than the prescribed limits.

In case the valid readings are not obtained within the 10 free-accelerations, the testing shall be discontinued and the vehicle owner shall be advised to re-submit the vehicle after the same is repaired / serviced.

4.5.1.7 For the purpose of PUC certification if the smoke is not within limits as per 5.0 below, the testing shall be discontinued and the vehicle owner shall be advised to re-submit the vehicle after the same is repaired / serviced.

5 Test Limits :

Method of Test	Maximum Smoke Density	
	Light absorption coefficient (1/m)	Hartidge units
Free acceleration test for turbo charged engine and naturally aspirated engine	2.45	65

6.0 Code of Practice for Authorised PUC Test Agencies :

The PUC test agencies authorised for issue of “Pollution Under Control Certificate” as per CMVR-115(7) shall comply with following Code of Practice.

- 6.1 The Type Approval certificate supplied by PUC equipment manufacturer / supplier shall be displayed in the PUC center.
- 6.2 The operator training certificate issued by PUC equipment manufacturer / supplier shall be displayed in the PUC center.
- 6.3 PUC operator shall submit the monthly report of all tested in-use vehicles along with test printout in original to the Transport Department.
- 6.4 PUC operator shall enter into AMC for a period of 5 years with the respective PUC equipment manufacturer based on the finalized charges.
- 7.0 Renewal of PUC Operator License

The license of PUC operator shall be renewed by the concerned Transport Authorities provided the PUC operator follows Code of Practice as per 5.0 above.