

CHAPTER 9 : TYPE II TEST ON SI ENGINES (VERIFYING CARBON MONOXIDE EMISSION AT IDLING)

1 Scope :

This Chapter describes the procedure for the TYPE II test for verifying carbon monoxide emission at idling of spark ignition engine vehicles, as defined in para 5.2.3 of Chapter 1 of this Part.

2 Test Instrument

2.1 The instrument used for the measurement of CO should meet the requirements given in Para 5.0.

2.2 The instrument should be prepared, used and maintained following the directions given in the instrument manufacturer's operation manual, and it should be serviced at such intervals as to ensure accuracy.

2.3 Within a period of 4 hours before the instrument is first used, and each time the instrument is moved or transferred to a new environment, a "span and zero" calibration should be carried out using calibration gas. The calibration shall be performed well away from the exhaust of motor vehicles whose engines are running.

2.4 If the sample handling system is not integral with the analyser, the effectiveness of the condensate traps and all connections of the gas sampling system should be checked. It should be checked that filters are clean, that filter holders are fitted with their gaskets and that these are in good conditions.

2.5 If the instrument is not self-compensated for non-standard conditions of altitude and ambient temperature or not equipped with manually controlled system of compensation, the scale calibration should be performed with calibration gas.

2.6 It should be ensured that the sample handling line and probe are free from contaminants and condensates.

3 Vehicle and Fuel :

3.1 This test should be carried out immediately after the sixth operating cycle of the Type I test, with the engine at idling speed, the cold start device not being used. Immediately before each measurement of the carbon monoxide content, a TYPE I test operating cycle as described in Chapter 3 of this Part shall be carried out.

3.1.1 In case the Type II test is carried out without Type I test, the following steps are to be taken for vehicle preparation :It should be checked that the road vehicle/engine in all its parts, components and systems conform to the declared particulars in the application for type approval.

- 3.1.2 It should be checked that the road vehicle exhaust system is leakproof and that the manual choke control has been returned to the rest position.
- 3.1.3 It should be checked that the gas sampling probe can be inserted into the exhaust pipe to a depth of at least 300 mm. If this proves impossible owing to the exhaust pipe configuration, a suitable extension to the exhaust pipe(s), making sure that the connection is leakproof, should be provided.
- 3.1.4 The vehicle shall have attained normal thermal conditions as defined in 2.3 of chapter 1 of this part immediately prior to the measurement, by running the vehicle on chassis dynamometer with specified number of warming up cycles declared by the manufacturer and six driving cycles.
- 3.1.5 The vehicle idling speed should be checked and set as per Para 2.2.1 chapter 1 with all the accessories switched off.

3.2 Fuel :

The fuel shall be the reference fuel whose specifications are given in Chapter 10 of this Part. If the engine is lubricated by mixture, the oil added to the reference fuel shall comply as to create and quantity with the manufacturer's recommendations.

4 Measurement :

- 4.1 Immediately preceding the measurement, the engine is to be accelerated to a moderate speed with no load, maintained for at least 15 seconds, then returned to idle speed.
- 4.2 While the engine idles, the sampling probe should be inserted into the exhaust pipe to a depth not less than 300 mm, if the probe prescribed in para 5.3.2.1 is used.
- 4.3 After the engine speed stabilises the reading should be taken. In the case of 2 & 3 wheeled vehicles fitted with air cooled engines, this stabilised speed may be outside the range specified by the manufacturer.
- 4.4 The value of CO concentration reading should be recorded.
- 4.5 In cases where gadgets or devices are incorporated in the exhaust system, for dilution of the exhaust, both CO and CO₂ should be measured using an instrument having facility to measure both CO and CO₂ . If the total of the

measured values of CO and CO₂ (T_{CO} and T_{CO2}) concentrations exceed 15% for four stroke engines and 10% for two stroke engines, the measured value of CO should be taken as carbon mono-oxide emissions from the vehicle. If it does not, the corrected value (T corrected) should be taken, as given below :-

$T_{\text{corrected}} = T_{\text{CO}} \times 15 / (T_{\text{CO}} + T_{\text{CO}_2})$ for 4 stroke engines.

$= T_{\text{CO}} \times 10 / (T_{\text{CO}} + T_{\text{CO}_2})$ for 2 stroke engines.

- 4.6 Multiple exhaust outlets should be connected to a manifold arrangement terminating in a single outlet. If a suitable adapter is not available, the arithmetic average of the concentrations from the multiple pipes may be used.
- 4.7 If the measurement is to be repeated, the entire procedure of para 4 shall be repeated.
- 5 Technical Specifications of Carbon Monoxide Analyser/Equipment for Road Vehicles
- 5.2 General : The carbon monoxide analyser shall be compatible with all types of motor vehicle operating environments and shall meet under the conditions and performance requirements listed uses 5.2 and 5.3.
- 5.2 Performance Criteria :
- 5.2.1 Analyser accuracy : The carbon monoxide analyser shall have an accuracy of $\pm 3\%$ of full scale, as determined by analysing known standard gases.
- 5.2.2 Interference effects : The sum of the individual effects on the reading of the analyser from other gases and particulates in concentration close to those existing in the engine exhaust gas shall be less than 0.2 unit.
- 5.2.3 System response time : The analyser concentration indication shall reach 90% of the final stabilised reading within 10 seconds after a step change in concentration level is initiated at the sample probe inlet.
- 5.2.4 Drift : Zero and span drift of a warmed-up instrument shall not be greater than $\pm 3\%$ of full scale during 1 hour of operation.
- 5.2.5 Repeatability_: Analyser repeatability shall be within $\pm 2\%$ of full scale during five successive samples of the same gas source.
- 5.2.6 Warm-up time : Unless otherwise indicated on the instrument, the analyser shall reach stabilised operation within 30 minutes from "power on".
- 5.2.7 Span :_The instrument shall have the capability of being spanned using both calibration gas bottles and electro-mechanical or electronic methods.
- 5.2.8 Sample handling system : The sample handling materials that are in contact with the gas sample shall not contaminate or change the character of the gases to be analysed.

All sampling system internal surfaces shall be corrosion resistant to motor vehicle exhaust gases.

The sample handling system shall provide for particulate and water removal as required to prevent these contaminants from effecting gas analysis. The filtering and water removal components shall be designed for easy maintenance.

5.2.9 Safety requirements : The construction, materials, and electrical systems used in the instrument system shall comply with local provisions. Each analyser system shall be constructed and shall incorporate safety devices for the protection of personnel and nearby equipment.

5.2.10 Temperature sensitivity : The instrument shall be suitable for ambient temperatures between 278K and 318K. Between these two limits, the result of the measurement shall not differ from that obtained at a temperature of $303K \pm 2K$ by more than 0.2 unit.

5.3 Design Characteristics :

5.3.1 Instrument construction : The instrument shall be designed and constructed to provide reliable and accurate service in the motor vehicle repair garage environment.

5.3.1.1 Mobility : The instrument may be permanently mounted, portable, or mobile.

5.3.1.2 Identification : The identification of the instrument shall be permanently attached to the outer surface of the analyser enclosure. The identification shall include the model and serial number, name and address of the instrument manufacturer, production date, electrical power requirements and operating voltage range.

5.3.1.3 Electrical design : Analyser operation shall be unaffected by an electrical voltage variation of $\pm 10\%$.

5.3.1.4 Controls : The span and zero controls should be readily accessible but protected against accidental misadjustment.

5.3.1.5 Electromagnetic isolation : The instrument system shall be capable of providing unaffected operation in electromagnetic radiation or conductive interference produced by vehicle ignition systems and building electrical systems.

5.3.1.6 Vibration and shock protection : System operation shall be unaffected by the vibration and shock encountered under the normal operating conditions in a motor vehicle repair garage.

5.3.1.7 Operating instructions : Concise operating instructions, including calibration procedures and instrument calibration curves, shall be supplied by the manufacturer with the instrument.

5.3.2 Sampling system : The vehicle exhaust gas sampling shall consist of an exhaust pipe probe and an analysis system and may include a water removal system and/or filter(s). The sampling line shall be a minimum 3 metres in length.

5.3.2.1 Probe : The probe design shall be such that it will not slip out of the motor vehicle exhaust pipe when in use of analysis. A thermally insulated, comfortable

hand grip shall be provided on the sample probe handle. The probe should be flexible enough to extend into the tailpipe at least 300 mm.

5.3.2.2 Alternatively the sampling probe etc can be placed in the pipe connecting the exhaust with CVS system and as close to the exhaust as possible. However, even after the test, if the manufacturer request so, test with this probe shall be considered invalid and in such cases a retest shall be carried out with the probe prescribed in para 5.3.2.1.

5.3.2.3 Water removal system : If a water removal system is required to remove vehicle exhaust gas water vapour from the sample gas prior to its entering the instrument analysers, the collection vessel shall be visible to the operator and a draining provision shall be provided.

5.3.3 Analytical system : The accuracy, system response time, drift, repeatability, and warm-up time shall be as specified in the performance criteria in para 5.2 above.

5.3.3.1 Instrument range : The instrument read-out shall have a range of 0 to 10% CO or less.

5.3.3.2 Span techniques : The instrument system shall have provisions for adjustment of the zero and span setting by calibration gas. A second type of span adjustment may be provided for electromechanical, electrical, electronic or other acceptable method.

If the instrument is not self-compensated for non-standard conditions of altitude and ambient temperature, or not equipped with a manually controlled system of compensation, the scale calibration shall be performed using calibration gas.

The carrier gas should be dry nitrogen. The accuracy of the span gas blends should be within $\pm 2\%$ of the concentration stated.

5.4 Instruments with facility for carbon-di-oxide measurement, also for applications mentioned in 4.5 shall meet all the above performance criteria mentioned for CO, except that the instrument read-out shall have a range of 0 to 20% CO₂ or less (clause 5.3.3.1).