

## CHAPTER 1 : OVERALL REQUIREMENTS

### 1 Scope :

This Part applies to the emission of gaseous pollutants from diesel engines used for driving motor vehicles. Diesel engined vehicles, GVW of which does not exceed 3500 kg, may be approved on the basis of test procedure of Part III as opted by the manufacturer.

### 2 Definitions :

- 2.1 Compression Ignition Engine : Means an internal combustion engine which operates on compression ignition principle (Diesel Engines).
- 2.2 Maximum Rated Speed : Means the maximum speed permitted by governor at full load.
- 2.3 Minimum Rated Speed : Means either the highest of the following three engine speeds -  
45% of maximum net power speed,  
1000 rev/min,  
minimum speed permitted by the idling control or  
such lower speed as the manufacturer may request.
- 2.4 Per Cent Load : Means the fraction of the maximum available torque at an engine speed.
- 2.5 Intermediate Speed : Means the speed corresponding to the maximum torque value if such speed is within the range of 60 to 75 % of rated speed; in other cases it means a speed equal to 60 % of rated speed.
- 2.6 Net Power : Means the power of a C.I. engine as defined in Chapter 6 of Part IV of this rule.
- 2.7 Unladen Mass : Means the mass of the vehicle in running order without crew, passengers or load, but with the fuel tank 90% full and the usual set of tools and spare wheel on board where applicable.
- 2.8 Gross Vehicle Weight (GVW) : Means the technically permissible maximum weight declared by the vehicle manufacturer.
- 2.9 Gaseous Pollutants: means carbon monoxide, hydrocarbons ( assuming a ratio of  $\text{CH}_{1.85}$ ) and oxides of nitrogen (expressed in nitrogen dioxide  $\text{NO}_2$  equivalent).
- 2.10 Cold Start Device : Means a device which enriches the airfuel mixture of the engine temporarily and thus to assist engine start up.
- 2.11 Starting Aid : Means a device which assists the engine start up without enrichment of the fuel mixture, e.g. glow plug, change of injection timing, etc.

- 2.12 Type Approval of a Vehicle : Means the type approval of a vehicle model with regard to the limitation of the emission of gaseous pollutants from the engine.
- 2.13 Vehicle Model : Means a category of power driven vehicles which do not differ in such essential respects of the vehicle characteristics which affects the vehicular emission and listed in Chapter 2 of this Part.
- 2.14 Vehicle for Type Approval Test : Means the fully built vehicle incorporating all design features for the model submitted by the vehicle manufacturer.
- 2.15 Vehicle for Conformity of Production : Means a vehicle selected at random from a production series of vehicle model which has already been type approved.
- 2.16 Abbreviations and Units

|                    |                   |   |
|--------------------|-------------------|---|
| P                  | kW                | net power output non-corrected          |
| CO                 | g/kWh             | Carbon Monoxide emission                |
| HC                 | g/kWh             | hydrocarbon emission                    |
| NO <sub>x</sub>    | g/kWh             | emission of oxides of nitrogen          |
| conc               | ppm               | concentration (ppm by volume)           |
| mass               | g/h               | pollutant mass flow                     |
| WF                 |                   | weighting factor                        |
| G <sub>EXH</sub>   | kg/h              | exhaust gas mass flow rate on wet basis |
| V' <sub>EXH</sub>  | m <sup>3</sup> /h | exhaust gas volume on dry basis         |
| V'' <sub>EXH</sub> | m <sup>3</sup> /h | exhaust gas volume on wet basis         |
| G <sub>AIR</sub>   | kg/h              | intake air mass flow rate               |
| V <sub>AIR</sub>   | m <sup>3</sup> /h | intake air volume flow rate             |
| G <sub>FUEL</sub>  | kg/h              | fuel mass flow rate                     |
| FID                |                   | flame ionisation detector               |
| NDIR               |                   | non-dispersive infra-red                |
| CLA                |                   | chemiluminescent analyser               |

### 3 Application for Type Approval :

- 3.1 The application for type approval of a vehicle model with regard to limitations of the emission of gaseous pollutants from its engine shall be submitted by the vehicle manufacturer with a description of the engine and vehicle model comprising all the particulars referred to in Chapter 2 of this Part.
- 3.2 A vehicle representative of the vehicle model to be type approved shall be submitted to the testing agency responsible for conducting tests referred in para 5 below.
- 4 Type Approval :  
If the vehicle submitted for approval pursuant to these rules, meet the requirements of para 5.0 below, approval of vehicle model shall be granted. The approval of the vehicle model pursuant to this part shall be communicated to the Vehicle Manufacturer & Nodal Agency by the testing agency in the form of Certificate of Compliance to CMVR, as envisaged in Rule-126 of CMVR.
- 4 Specifications and Tests :
- 5.1 General : The components liable to affect the emission of gaseous pollutants shall be so designed, constructed and assembled as to enable the engine, in normal use, despite the vibration to which it may be subjected, to comply with the provisions of this Rule.
- 5.2 Specifications Concerning the Emission of Pollutants :  
  
The emission of pollutants by the engine submitted for testing shall be measured by the method described in Chapter 3 of this Part. Other methods may be approved if it is found that they yield equivalent results.
- 5.2.1 The power of engine measured at the test bench during the test at steady speeds of the engine as detailed in the full load curve, as detailed in Chapter 6 of Part IV may differ from the power specified by the manufacturer in Chapter 2 of this Part :
- 5.2.1.1 For Type Approval :  
For single cylinder engines,  $\pm 5\%$  at Max. Power point &  $\pm 10\%$  at other measurement points, and for other engines by  $\pm 2\%$  at Max. Power Point &  $+6\%$  &  $-2\%$  at other measurement points.
- 5.2.1.2 For Conformity of Production : For Single Cylinder engines by  $\pm 10\%$  & for other engines by  $-5\%$  /  $+8\%$  at maximum power point.
- 5.2.2 The mass of the carbon monoxide, the mass of the hydrocarbons and the mass of the nitrogen oxides obtained when tested as per details given in Chapter 3 of this Part shall not exceed the amounts shown in the table below:-

|                                   |                                 |  |
|-----------------------------------|---------------------------------|--|
| Mass of Carbon Monoxide(CO) g/kWh | Mass of Hydro Carbons(HC) g/kWh | Mass of Oxides of Nitrogen (Nox) g/kWh |
|-----------------------------------|---------------------------------|--|

|    |     |    |
|----|-----|----|
| 14 | 3.5 | 18 |
|----|-----|----|

- 5.3 In case of diesel engined vehicles of GVW less than 3500 kg, if the manufacturer opts to meet the requirements as per Part the requirements of 5.2.2 and 5.2.3 above need not be met, but the requirement given in 5.3.1 below should be met, when tested as per procedure given in Chapter 1 and Chapter 3 of Part III.

Emission Standards for Type I test for compression ignition engined vehicles :

| Reference mass R (kg) more than | Reference mass R (kg) upto and including | CO (g/km) | Combined emission of HC+NOx(g/km) |
|---------------------------------|--|-----------|-----------------------------------|
| ---                             | 1020                                     | 14.3      | 4.7                               |
| 1020                            | 1250                                     | 16.5      | 5.1                               |
| 1250                            | 1470                                     | 18.8      | 5.4                               |
| 1470                            | 1700                                     | 20.7      | 5.8                               |
| 1700                            | 1930                                     | 23.0      | 6.2                               |
| 1930                            | 2150                                     | 24.9      | 6.5                               |
| 2150                            | ---                                      | 27.1      | 6.9                               |

## 6 Modifications of the vehicle Model :

- 6.1 Every modification in the essential characteristics of the Vehicle shall be intimated by the Vehicle Manufacturer to the test agency which Type approved the Vehicle model. The test agency may either :

6.1.1 Consider that the Vehicle with the modifications made may still comply with the requirement, or

6.1.2 Require a further test to ensure compliance.

- 6.2 In case of 6.1.1 above, the testing agency shall extend the type approval covering the modified specification.

In case of 6.1.2 above, the vehicle model shall be subjected to necessary test. In case the vehicle complies with the requirements, the test agency shall extend the type approval.

6.3 Any changes to the procedure of PDI and running in concerning emission shall also be intimated to the test agency by the vehicle manufacturer, whenever such changes are carried out.

## 7 Conformity of Production :

7.1 Every produced vehicle of the model approved under this rule shall conform, with regard to components affecting the emission of gaseous pollutants by the engine to the vehicle model type approved. The procedure for carrying out conformity of production tests is given in Part VI of this Document.

7.2 For verifying the conformity of the engine in a test, the following procedure is adopted:-

7.2.1 An engine is taken from the series and subjected to the test described in Chapter 3 of this Part.

7.2.1.1 If the engine taken from the series does not satisfy the requirements of Paragraph 5.2.2 and 5.2.3 above, the manufacturer may ask for measurements to be performed on a sample of engines taken from the series and including the engine originally taken. The Manufacturer shall specify the size n of the sample subject to n being minimum 2 and maximum 10, including the engine originally taken. The engines other than originally tested shall be subjected to single Type I test. The result to be taken into consideration for the engine taken originally is the arithmetical mean ' $\bar{x}$ ' of the results obtained with the sample and the standard deviation S of the sample shall then be determined for each gaseous pollutant. The production of the series shall then be deemed to conform if the following condition is met :-

$$\bar{x} + k.S \leq L$$

where :-

$$S^2 = \Sigma (x - \bar{x})^2 / (n - 1)$$

x = any one of the individual results obtained with the sample n.

L = the limit value laid down in Paragraph 5.2.3 for each gaseous pollutant considered; and

k = a statistical factor depending on 'n' and given in the following table:-

| n | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| k | 0.973 | 0.613 | 0.489 | 0.421 | 0.376 | 0.342 | 0.317 | 0.296 | 0.279 |

7.2.1.2 Alternatively if the Manufacturer requests so, the Conformity of Production can be verified by the following alternative sampling plan.

7.2.1.3 A failed Engine is one whose test results, lead to one or more of the limit values in Para 7.2.1 being exceeded.

7.2.1.4 The production of the series is deemed to conform or not to conform by testing engines comprising a test sample until a pass decision is reached for all limit values or a fail decision is reached for one limit value. A pass decision is reached when the cumulative number of failed engines as defined in Para 7.2.1.2. for each value is less than or equal to the pass decision number appropriate to the cumulative number of engines tested. A fail decision is reached when the cumulative number of engines for one limit value is greater than or equal to the fail decision number appropriate to the cumulative number of engines tested. Once a pass decision has been made for a particular limit value the number of engines whose results exceed that limit value must not be considered any further for the purposes of checking conformity of production. The pass and fail decision numbers associated with the cumulative number of engines tested are illustrated in the fig.2 given in the following Table.

7.2.1.5 The testing agency responsible for verifying the conformity of production shall carry out tests on engines which have been run-in partially or completely, according to the manufacturer's specifications.

7.3 In the case of engine type approved as per 5.3, the conformity of production test procedure will be as per 8.4 of Chapter 1 of Part III and the limits will be as per 7.3.1 below :

7.3.1 Emission Standards for Type I Tests for Compression Ignition Engined Vehicles.

| Reference mass R<br>(kg) more than | Reference mass R<br>(kg) upto and<br>including | CO (g/km) | Combined emission<br>of HC+NO <sub>x</sub> (g/km) |
|------------------------------------|--|-----------|---|
| ---                                | 1020   | 17.3      | 5.9   |
| 1020                               | 1250   | 19.7      | 6.3   |
| 1250                               | 1470   | 22.5      | 6.8   |
| 1470                               | 1700   | 24.9      | 7.3   |
| 1700                               | 1930   | 27.6      | 7.7   |
| 1930                               | 2150   | 29.9      | 8.2   |
| 2150                               | ---  | 32.6      | 8.6   |

Fig. 2:-TABLE : PASS FAIL CRITERIA (See para. 7.2.1.4 chapter 1 part 5)

| Cumulative<br>number<br>vehicles tested | Pass decision<br>(No.of<br>failures) | Fail decision<br>(No. of<br>failures) | Cumulative<br>number of<br>vehicles tested | Pass decision<br>( No. of<br>failures) | Fail decision<br>(No. of<br>failures) |
|---|--------------------------------------|---------------------------------------|--|--|---------------------------------------|
| 1                                       | ( <sup>+</sup> )                     | ( <sup>-</sup> )                      | 31   | 14                                     | 20                                    |

|    |     |     |    |    |    |
|----|-----|-----|----|----|----|
| 2  | (°) | (:) | 32 | 14 | 21 |
| 3  | (°) | (:) | 33 | 15 | 21 |
| 4  | (°) | (:) | 34 | 15 | 22 |
| 5  | 0   | (:) | 35 | 16 | 22 |
| 6  | 0   | 6   | 36 | 16 | 23 |
| 7  | 1   | 7   | 37 | 17 | 23 |
| 8  | 2   | 8   | 38 | 17 | 24 |
| 9  | 2   | 8   | 39 | 18 | 24 |
| 10 | 3   | 9   | 40 | 18 | 25 |
| 11 | 3   | 10  | 41 | 19 | 26 |
| 12 | 4   | 10  | 42 | 19 | 26 |
| 13 | 4   | 11  | 43 | 20 | 27 |
| 14 | 5   | 11  | 44 | 21 | 27 |
| 15 | 5   | 12  | 45 | 21 | 28 |
| 16 | 6   | 12  | 46 | 22 | 28 |
| 17 | 6   | 13  | 47 | 22 | 29 |
| 18 | 7   | 13  | 48 | 23 | 29 |
| 19 | 7   | 14  | 49 | 23 | 30 |
| 20 | 8   | 14  | 50 | 24 | 30 |
| 21 | 8   | 15  | 51 | 24 | 31 |
| 22 | 9   | 15  | 52 | 25 | 31 |
| 23 | 9   | 16  | 53 | 25 | 32 |
| 24 | 10  | 16  | 54 | 26 | 32 |

|  |    |    |    |    |    |
|--|----|----|----|----|----|
| 25   | 11 | 17 | 55 | 26 | 33 |
| 26   | 11 | 17 | 56 | 27 | 33 |
| 27   | 12 | 18 | 57 | 27 | 33 |
| 28   | 12 | 19 | 58 | 28 | 33 |
| 29   | 13 | 19 | 59 | 28 | 33 |
| 30   | 13 | 20 | 60 | 32 | 33 |
| (‘) Series not able to pass at this stage<br>(:) Series not able to fail at this stage |    |    |    |    |    |