

## CHAPTER 1 : OVERALL REQUIREMENTS

### 1. Scope :

- 1.1 This Part applies to the tailpipe emission of vehicles equipped with spark ignition engines (Petrol,CNG,LPG) and compression ignition engines(Diesel,CNG,LPG).
- 1.2 The method of test for mass emission given in this Part may also be used at the manufacturer's option for compression ignition engined vehicles wherever applicable with Gross Vehicle Weight (GVW) not exceeding 3500 kg, instead of Part X.
- 1.3 This Part should be read in conjunction with the applicable Gazettee Notification for which the vehicle is subjected to test.

### 2. Definitions :

- 2.1 Spark Ignition Engine : Means an internal combustion engine in which the combustion of the air/fuel mixture is initiated at given instants by a hot spot, usually an electric spark.
- 2.2 Compression Ignition Engine : Means an engine which works on the compression-ignition principle (e.g. diesel engine).
- 2.3 Idle Speed : Means the engine rate, in revolution per minute, with fuel system controls (accelerator and choke) in the rest position, transmission in neutral and clutch engaged in the case of vehicles with manual or semi-automatic transmission, or with selector in park or neutral position when an automatic transmission is installed, as recommended by the manufacturer.
- 2.4 Normal Thermal Conditions : Means the thermal conditions attained by an engine and its drive line after a run of at least 15 minutes on a variable course, under normal traffic conditions.
- 2.5 Gaseous Pollutants : Means carbon monoxide, hydrocarbons (assuming a ratio of  $\text{CH}_{1.85}$ ) and oxides of nitrogen, (being expressed in Nitrogen dioxide  $[\text{NO}_2]$  equivalent.)
- 2.6 Particulate Pollutants : Means components of exhaust gas which are removed from the diluted exhaust gas at a maximum temperature of  $52^\circ\text{C}$  (325 K) by means of filters described in Chapter 3 of this part.

- 2.7 Tailpipe emissions means
- For positive ignition engines, the emission of gaseous pollutants
  - For compression ignition engines, the emission of gaseous and particulate pollutants.
- 2.8 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. In the case of 3-wheeled tractors, designed for coupling to a semi-trailer, the unladen mass will be that of the drawing vehicle.
- 2.9 Reference Mass : Means the "Unladen Mass" of the vehicle increased by a uniform figure of 75 kg for 2 wheeled vehicles; and 150 kg for all other vehicles.
- 2.10 Gross Vehicle Weight (GVW) : Means the technically permissible maximum weight declared by the vehicle manufacturer. In case of the 3 wheeled vehicles designed to be coupled to a semi-trailer, the mass GVW to be taken into consideration when classifying that vehicle, shall be the maximum weight of the tractor in running order, plus the weight transferred to the tractor by the laden semi-trailer in static condition.
- 2.11 Cold Start Device : Means a device which enriches the air fuel mixture of the engine temporarily and, thus, to, assist engine start up like choke.
- 2.12 Starting Aid : Means a device which assists engine start up without enrichment of the fuel mixture, e.g. glow plug, change of injection timing for fuel-injected spark ignition engine, etc.
- 2.13 Engine capacity means : For reciprocating piston engines, the nominal engine swept volume.
- 2.14 Anti pollution device : means those components of the vehicles that control and / or limit tail pipe and evaporative emissions
- 2.15 Type Approval of a vehicle : Means the type approval of a vehicle model with regard to the limitation of tailpipe emissions from the vehicles.

- 2.16 Vehicle Model : Means a category of power-driven vehicles which do not differ in such essential respects as the equivalent inertia determined in relation to the reference weight of engine and vehicle characteristics which effects the vehicular emission and listed in Chapter 2 of this Part.
- 2.17 Vehicle for Type Approval Test : Means the fully built vehicle incorporating all design features for the model submitted by the vehicle manufacturer.
- 2.18 Vehicle for Conformity of Production : Means a vehicle selected at random from a production series of vehicle model which has already been type approved.
3. Application for Type Approval :
- 3.1 The application for type approval of a vehicle model with regard to limitation of tailpipe emissions from the vehicles 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.

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 of this Chapter.

4. Type Approval :

If the vehicle submitted for type approval pursuant to these rules, meet the requirements of para 5 below, approval of that vehicle model shall be granted. The approval of the vehicle model pursuant to this part shall be communicated to the vehicle manufacturer and nodal agency by the testing agency in the form of certificate of compliance to the CMVR, as envisaged in Rule-126 of CMVR.

5. Specification and Tests :

- 5.1 General : The components liable to affect the tailpipe emissions of gaseous pollutants shall be so designed, constructed and assembled to enable the vehicle, in normal use, despite the vibrations to which they may be subjected to comply with the provisions of this rule.
- 5.2 Specifications concerning the emissions of pollutants
- 5.2.1 The vehicle shall be subjected to tests of Type I and II as specified below according to the category it belongs.
- 5.2.2 Type I Test: (Verifying the average tailpipe emissions)

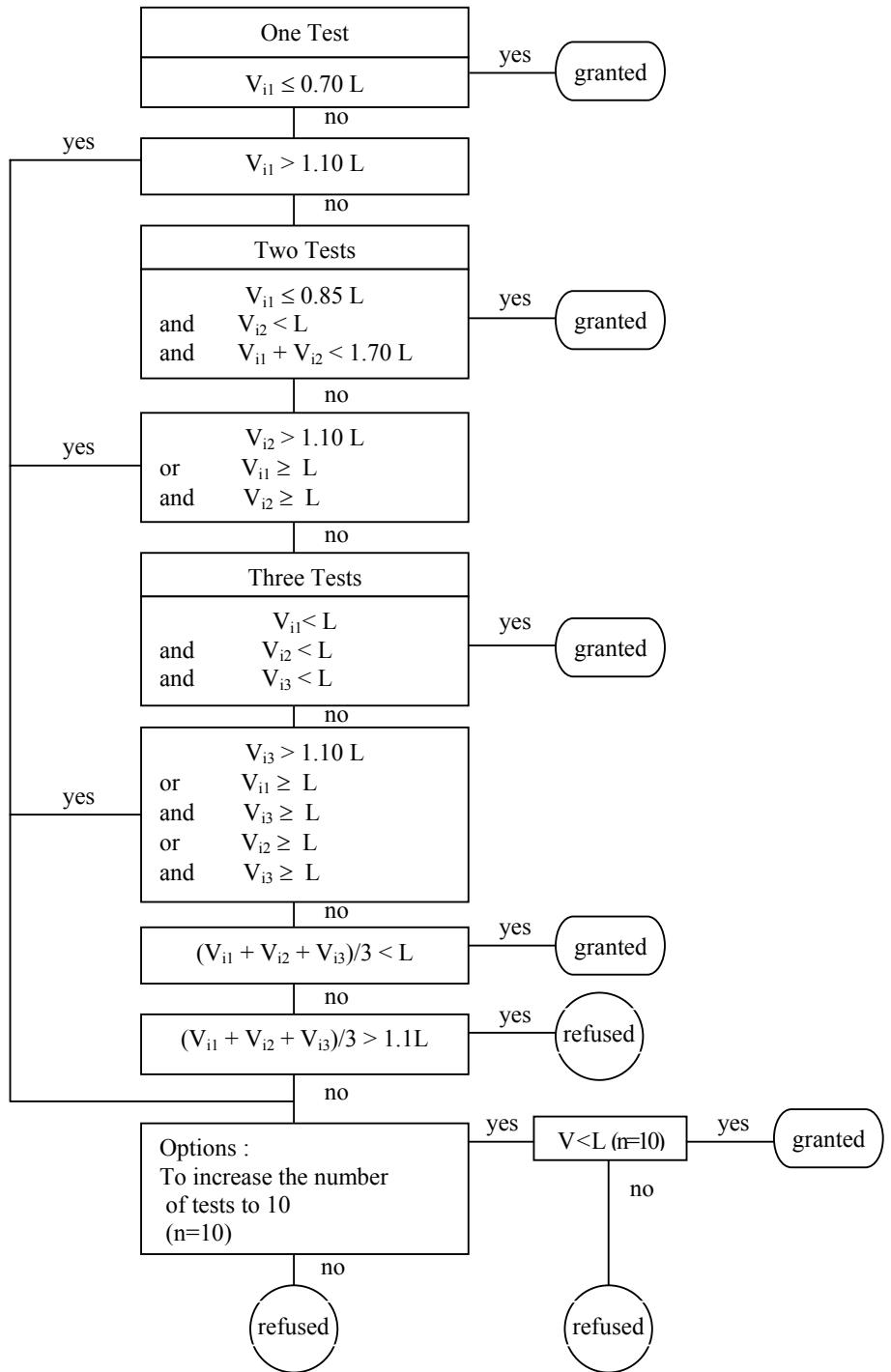
- 5.2.2.1 The vehicle shall be placed on a Chassis dynamometer bench equipped with a means of load and inertia simulation.
- 5.2.2.2 For 2&3-wheel vehicles, a test lasting a total of 648 seconds and comprising of six cycles as described in Chapter 3 of Part III shall be carried out, without interruption.
- 5.2.2.3 For all 4-wheel vehicles, a test lasting a total of 19 minutes and 40 seconds made up of two parts, One and Two, shall be performed without interruption. An unsampled period of not more 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.
- 5.2.2.3.1 Part One of the test cycle is made up of 4 elementary urban cycles. Each elementary urban cycle comprises 15 phases (idling, acceleration, steady speed, deceleration ).
- 5.2.2.3.2 Part Two of the test cycle is made up of one extra urban cycle. The extra urban cycle comprises 13 phases (idling, acceleration, steady speed, deceleration ).
- 5.2.2.4 During the test the exhaust gases shall be diluted with air and a proportional sample collected in one or more bags. The contents of the bags will be analysed at the end of the test. The total volume of the diluted exhaust shall be measured. Carbon monoxide (CO), hydro carbon (HC) and nitrogen oxide emissions (NO<sub>x</sub>), and in addition particulate matter (PM) the case of vehicles equipped with compression ignition engines shall be recorded. Carbon dioxide shall also be recorded for the purpose of calculation of fuel consumption.
- 5.2.2.5 The test shall be carried out by the procedure described in Chapter 3 of Part IX. The methods used to collect and analyse the gases and to remove and weigh the particulates shall be as prescribed.
- 5.2.2.6 Subject to the provisions of the paragraphs 5.2.2.8 & 5.2.2.9, the test shall be repeated three times, the test results shall be multiplied by appropriate deterioration factors. The resulting masses of gaseous emission and, in the case of vehicles equipped with compression-ignition engines, the mass of particulates obtained in each test shall not exceed the applicable limits.
- 5.2.2.7 Type Approval and Conformity of Production Mass Emission Standards for Type I test :
- 5.2.2.7.1 Mass emission standards for vehicles manufactured on and after 1<sup>st</sup> April 2000 (India Stage I norms) shall be as per the details given in Rule no. 115(10) of CMVR, as amended from time to time for petrol

and diesel vehicles. For CNG and LPG vehicles, this rule should be read in conjunction with Rule 115(B) and 115(C).

- 5.2.2.7.2 Mass emission standards (Bharat Stage II) shall be as per the details given in Rule No.115(11) of CMVR, as amended from time to time, for petrol and diesel vehicles. For CNG and LPG vehicles, this rule should be read in conjunction with the rule 115(B) and 115(C)
- 5.2.2.8 Nevertheless, for each of the pollutants or combination of pollutants one of the three results obtained may exceed by not more than 10% of the applicable limits prescribed for the vehicle concerned, provided the arithmetical mean of the three results is not exceeding the prescribed limit. Where the prescribed limits are exceeded for more than one pollutant, it shall be immaterial whether this occurs in the same test or in different tests.
- 5.2.2.9 The number of tests prescribed in Para 5.2.2.8 above shall be reduced in the conditions hereinafter defined, where  $V_1$  is the result of the first test and  $V_2$  the result of the second test for each of the pollutants referred to in Para 5.2.2.6 above.
- 5.2.2.9.1 Only one test shall be performed if the result obtained for each pollutant or the sum of values for pollutants in case of the limit is so specified (e.g. HC &  $\text{NO}_x$ ) is less than or equal to 0.7 L i.e.  $V_1 \leq 0.70$  L.
- 5.2.2.9.2 If the requirements of 5.2.2.9.1 is not satisfied, only two tests are performed if for each pollutant or s or the sum of values for pollutants in case of the limit is so specified (e.g. HC &  $\text{NO}_x$ ), the following requirements are met.  
 $V_1 \leq 0.85$  L and  $V_1 + V_2 < 1.7$  L and  $V_2 \leq L$ .

Fig.1 depicts the scheme.

**Figure 1 : Flow Sheet for the Type Approval and COP Tests as per India Stage-I and Type Approval Test as per Bharat Stage II**



### 5.2.3 Type II Test (Test for carbon monoxide emissions at idling speed)

5.2.3.1 This is applicable only for spark ignition engined vehicles.

5.2.3.2 The carbon monoxide content by volume of the exhaust gases emitted with the engine idling must not exceed 4.5%, for three wheeled vehicles and its derivatives, including tractors for semi-trailers and two wheeled vehicles and 3.0% for all other vehicles when a test is made in accordance with the provisions of Chapter 9 of this Part.

## 6. Modifications of the vehicle Model :

6.1 Every modification in the essential characteristics of the vehicle model 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 Require a further test to ensure further compliance.

6.2 In case of 6.1.1 above, the testing agency shall extend the type approval covering the modified specification or the vehicle model shall be subjected to necessary tests. 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. Model Changes :

7.1 Vehicle models of Different Reference Weights and coast down coefficients :

Approval of a vehicle model may under the following conditions be extended to vehicle models which differ from the type approved only in respect of their reference weight.

7.1.1 Approval may be extended to vehicle model of a reference weight requiring merely the use of the next two steps higher or any lower equivalent inertia.

7.1.2 If the reference weight of the vehicle model for which extension of the type approval is requested requires the use of a flywheel of equivalent inertia lower than that used for the vehicle model already approved, extension of the type approval shall be granted if the masses of the pollutants obtained from the vehicle already approved are within the limits prescribed for the vehicle for which extension of the approval is requested.

7.1.3 If different body configurations are used with the same power plant and drive line and the change in the load equation due to changes in the coefficient of resistances that is within the limits that would be caused by the change of inertia as permitted by Clause 7.1.1 above the approval may be extended.

## 7.2 Vehicle models with Different Overall Gear Ratios :

7.2.1 Approval granted to a vehicle model may under the following conditions be extended to vehicle models differing from the type approved only in respect of their overall transmission ratios;

7.2.1.1 For each of the transmission ratios used in the Type I Test, it shall be necessary to determine the proportion

$$E = (V_2 - V_1)/V_1,$$

where  $V_1$  and  $V_2$  are respectively the speed at 1000 rev/min of the engine of the vehicle model type approved and the speed of the vehicle model for which extension of the approval is requested.

7.2.2 If for each gear ratio  $E \leq 8\%$ , the extension shall be granted without repeating the Type I Tests.

7.2.3 If for at least one gear ratio,  $E > 8\%$  and if for each gear ratio  $E \leq 13\%$  the Type I test must be repeated, but may be performed in laboratory chosen by the manufacturer subject to the approval of the test agency granting type approval. The report of the tests shall be submitted to the test agency by the manufacturer. .



- 7.3 Vehicle models of Different Reference Weights, coefficient of coast down and Different Overall Transmission Ratios Approval granted to a vehicle model may be extended to vehicle models differing from the approved type only in respect of their reference weight, coefficient of coast down and their overall transmission ratios, provided that all the conditions prescribed in Para 7.1 and 7.2 above are fulfilled.
- 7.4 Note : When a vehicle type has been approved in accordance with the provisions of Para 7.1 to 7.3 above, such approval may not be extended to other vehicle types.
- 7.5 Vehicle model with different makes of emission related components:
- 7.5.1 the names of suppliers of items such as ignition coil, magneto, CB point, air filter, silencer, etc. mentioned above, the manufacturers shall inform the test agency that In addition to carried out the type approval, the names of new alternate suppliers for these items as and when they are being introduced.
- 7.5.2 At the time of first type approval or for a subsequent addition of a make for a particular part, work out the combinations of tests in such a way that each make of such parts are tested at least once.
- 8 Conformity of Production :
- 8.1 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 administrative procedure for carrying out conformity of production is given in Part VI of this document.
- 8.2 Type I Test : Verifying the average emission of gaseous pollutants : For verifying the conformity of production in a Type I Test, the following procedure is adopted :-
- 8.2.1. The vehicle sample taken from the series, as described in 8.1 is subjected to the test described in para 5.2.2 above. The results shall be multiplied by the appropriate deterioration factors The result masses of gaseous emissions and in addition in case of vehicles equipped with compression ignition engines, the mass of particulates obtained in the test shall not exceed the applicable limits.
- 8.2.2 For compliance of India Stage I norms :  
If the vehicle taken from the series does not satisfy the requirements of the applicable standards, the manufacturer may ask for measurements to be performed on a sample of vehicles taken from the series and including the vehicle originally taken. The manufacturer shall specify the size 'n' of the sample subject to 'n' being minimum 2 and maximum 10, including the vehicle originally taken. The vehicles other than originally tested shall be subjected to single Type I test. The result to be taken into consideration for the vehicle taken originally is the arithmetical mean of the three Type I tests carried out on the vehicle. The arithmetical mean  $\bar{x}$  of the

results obtained with the random samples and the standard deviation S of the samples shall then be determined for the carbon monoxide emissions, the combined hydrocarbon and nitrogen oxide emissions and the particulate emissions. The production of the series shall then be deemed to conform if the following condition is met :

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

where  $S^2 = \frac{\sum(x_i - \bar{x})^2}{(n-1)}$

$x_i$  - the individual results obtained with the sample 'n'.

L - the limit value prescribed for the vehicle for each pollutant considered; and

k - a statistical factor dependent on 'n' and given by 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

### 8.3 Type II Test : Carbon-monoxide emission at idling speed

When the vehicle taken from the series for the type I test mentioned in 8.2 para above, subjected to the test described in Chapter 9 of this Part for verifying the carbon monoxide emission at idling speed should meet the limit values specified in para 5.2.3.2 above. If it does not, another 10 vehicles shall be taken from the series at random and shall be tested as per Chapter 9 of this Part. At least 9 vehicles should meet the limit values specified in para 5.2.3.2 above. In addition, two vehicles at random should be selected from the above lot of 10 and subjected to a Type I test mentioned in para 8.2 above and they should meet the requirements of para 5.2.2.7 above. Then the series is deemed to conform.

### 8.4 Procedure for Conformity of Production as per Bharat Stage-II

8.4.1 Conformity of production shall be verified as per Bharat Stage-II emission norms as given in para 5.2.2.7.2 and with the procedure given below.

8.4.2 To verify the average tailpipe emissions of gaseous pollutants following procedure shall be adopted :

8.4.2.1 Minimum of three vehicles shall be selected randomly from the series with a sample lot size.

- 8.4.2.2 After selection by the authority, the manufacturer must not undertake any adjustments to the vehicles selected, except those permitted in Part VI.
- 8.4.2.3 First vehicle out of three randomly selected vehicles shall be tested for Type - I test as per Para 5.2.2 of chapter 1 of this part.
- 8.4.2.4 Only one test ( $V_1$ ) shall be performed if the test results for all the pollutants meet 70 % of their respective limit values (i.e.  $V_1 \leq 0.7L$  &  $L$  being the COP Limit)
- 8.4.2.5 Only two tests shall be performed if the first test results for all the pollutants doesn't exceed 85% of their respective COP limit values (i.e.  $V_1 \leq 0.85L$ ) and at the same time one of these pollutant value exceeds 70% of the limit (i.e.  $V_1 > 0.7L$ ) In addition, to reach the pass decision for the series, combined results of  $V_1$  &  $V_2$  shall satisfy such requirement that :  $(V_1 + V_2) < 1.70L$  and  $V_2 \leq L$  for all the pollutants.
- 8.4.2.6 Third Type - I ( $V_3$ ) test shall be performed if the para 8.4.2.5 above doesn't satisfy and if the second test results for all pollutants are within the 110% of the prescribed COP limits, Series passes only if the arithmetical mean for all the pollutants for three type I tests doesn't exceed their respective limit value (i.e.  $(V_1 + V_2 + V_3)/3 \leq L$ )
- 8.4.2.7 If one of the three test results obtained for any one of the pollutants exceed 10% of their respective limit values the test shall be continued on Sample No. 2 & 3 as given in the Figure - 2 of chapter 1 of this part, as the provision for extended COP and shall be informed by the test agency to the nodal agency. These randomly selected sample No.2 & 3 shall be tested for only one Type - I test as per para 5.2.2.
- 8.4.2.8 Let  $X_{i2}$  &  $X_{i3}$  are the test results for the Sample No.2 & 3 and  $X_{i1}$  is the test result of the Sample No.1 which is the arithmetical mean for the three type - I tests conducted on Sample No. 1
- 8.4.2.9 If the natural Logarithms of the measurements in the series are  $X_1, X_2, X_3, \dots, X_j$  and  $L_i$  is the natural logarithm of the limit value for the pollutant, then define :

$$d_j = X_j - L_i$$

$$d_n = \frac{1}{n} \sum_{j=1}^n d_j$$

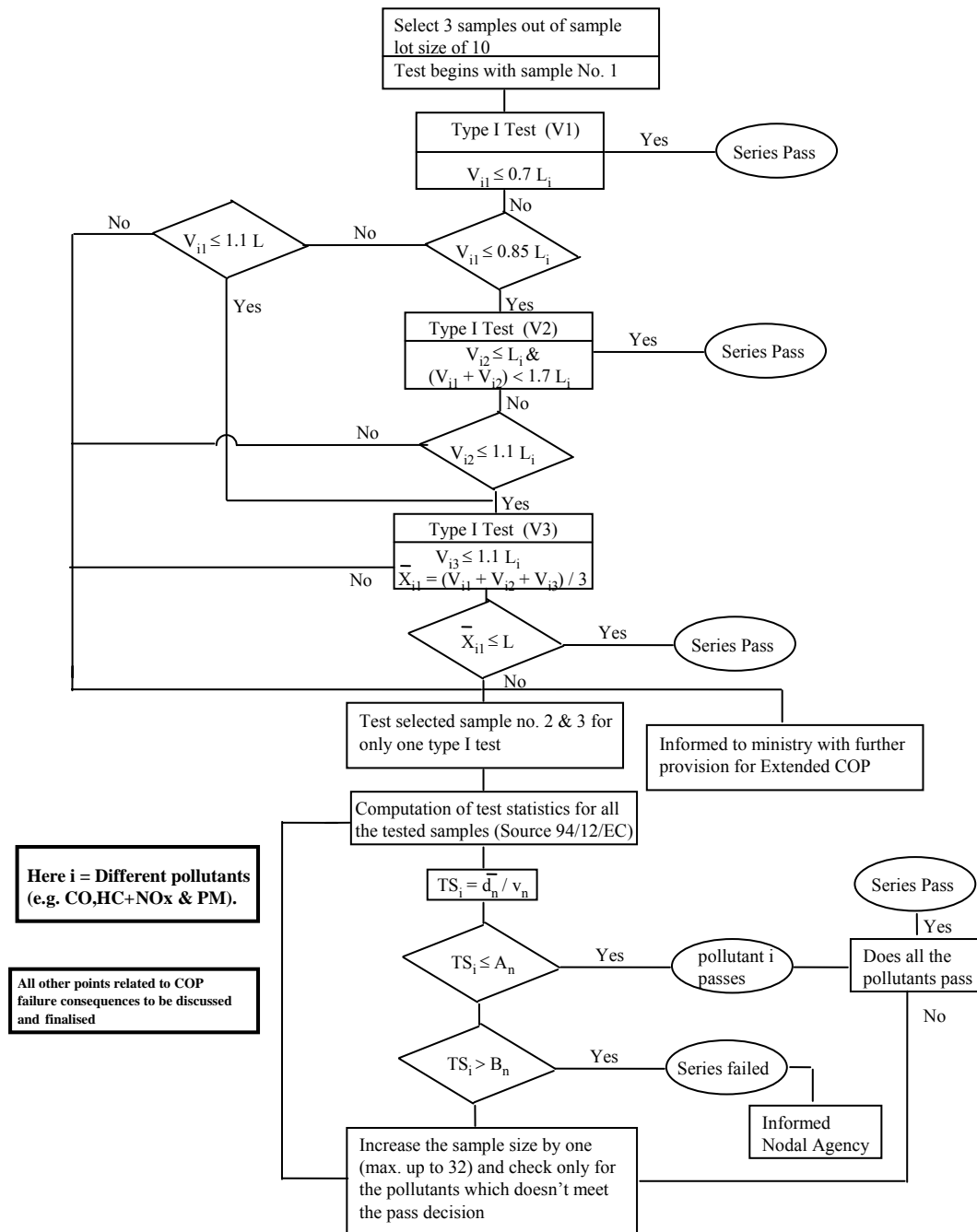
$$V_n^2 = \frac{1}{n} \sum_{j=1}^n (d_j - \bar{d}_n)^2$$

- 8.4.2.10 Table I of Chapter 1 of this part shows values of the pass ( $A_n$ ) and fail ( $B_n$ ) decision numbers against current sample number. The test statistic is the ratio  $\bar{d}_n / V_n$  and must be used to determine whether the series has passed or failed as follows :

- Pass the series, if  $\bar{d}_n/V_n \geq A_n$  for all the pollutants
- Fail the series if  $\bar{d}_n/V_n \geq B_n$  for any one of the pollutants.
- Increase the sample size by one, if  $A_n < \bar{d}_n/V_n \leq B_n$  for any one of the pollutants. When a pass decision is reached for one pollutant, that decision will not be changed by any additional tests carried out to reach a decision for the other pollutants.
- If no pass decision is reached for all the pollutants and no fail decision is reached for one pollutant, a test shall be carried out on another randomly selected sample till a pass or fail decision is arrived at.

8.4.2.11 Running in may be carried out at the request of the manufacturer either as per the manufacturers recommendation submitted during type approval or with a maximum of 3000 km for the vehicles equipped with a positive ignition engine and with a maximum of 15000 km for the vehicles equipped with a compression ignition engine.

8.4.2.12 All these tests shall be conducted with the reference fuel as specified in the applicable gazette notification. However, at the manufacturer's request, tests may be carried out with commercial fuel.



**Figure 2 : COP Test Procedure as per Bharat Stage II**

**Table I : Applicable for COP Procedure as per Bharat Stage II**

Sample size (n)	Pass decision threshold (A <sub>n</sub> )	Fail decision threshold (B <sub>n</sub> )
3 (including first sample)	-0.80381	16.64743
4	-0.76339	7.68627
5	-0.72982	4.67136
6	-0.69962	3.25573
7	-0.67129	2.45431
8	-0.64406	1.94369
9	-0.61750	1.59105
10	-0.59135	1.33295
11	-0.56542	1.13566
12	-0.53960	0.97970
13	-0.51379	0.85307
14	-0.48791	0.74801
15	-0.46191	0.65928
16	-0.43573	0.58321
17	-0.40933	0.51718
18	-0.38266	0.45922
19	-0.35570	0.40788
20	-0.32840	0.36203
21	-0.30072	0.32078
22	-0.27263	0.28343
23	-0.24410	0.24943
24	-0.21509	0.21831
25	-0.18557	0.18970
26	-0.15550	0.16328
27	-0.12483	0.13880
28	-0.09354	0.11603
29	-0.06159	0.09480
30	-0.02892	0.07493
31	0.00449	0.05629
32	0.03876	0.03876