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भारतीय मानक

स्वचल वाहन — ईंधन खपत के मूल्यांकन की पद्धति  
( पहला पुनरीक्षण )

*Indian Standard*

AUTOMOTIVE VEHICLES — METHOD OF  
EVALUATION OF FUEL CONSUMPTION

*( First Revision )*

UDC 629·113 : 621·43·018·3

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**BUREAU OF INDIAN STANDARDS**  
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NEW DELHI 110002

## FOREWORD

This Indian Standard ( First Revision ) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Vehicles Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

This standard originally published in 1986 is being revised in line with ISO 7860 : 1983 'Road vehicles—Motorcycles—Method of measuring fuel consumption'. Further, the accessories having impact on fuel consumption have been identified.

The Composition of the Committee responsible for the preparation of this standard is given in Annex C.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values ( *revised* )'.

## *Indian Standard*

# AUTOMOTIVE VEHICLES — METHOD OF EVALUATION OF FUEL CONSUMPTION

( *First Revision* )

### 1 SCOPE

This standard specifies the method of test for assessing fuel consumption at constant speed on a test track for all automotive vehicles ( other than two wheelers ) meant for transportation of passengers.

### 2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
1448 Series	Methods of test for petroleum and its products ( <i>see Annexes A &amp; B</i> )
1460 : 1974	Diesel fuels ( <i>second revision</i> )
2796 : 1971	Motor gasoline ( <i>first revision</i> )
9211 : 1979	Denomination and definitions of weights of road vehicles

### 3 FEATURES OF TEST TRACK

**3.1** The test track shall be straight, level paved road, covered with asphalt, concrete or similar material, dry, clean and smooth and shall have sufficient length on either side for the vehicle to attain and stabilise the test speed and also for stopping the vehicle at the end of test.

**3.2** The longitudinal and lateral slope of the test track shall not be more than 0.5 percent and 2 percent respectively. The altitude difference between any two points 1 000 m apart shall not be more than one metre.

**3.3** The test track shall have suitable marking to enable the driver to drive the vehicle along a straight line.

**3.4** Where sufficient length of track is not available to conduct the test at the relevant test speed, test track meeting the conditions as per **3.4.1** may be used.

**3.4.1** It shall be a straight line track of sufficient length to provide a test stretch of at least 1 000 m or form a closed circuit of at least 2 000 m in length and having a minimum radius of 200 m and be suitably banked at the

bends. The longitudinal and lateral slopes on the test track shall not exceed 1 percent and 3 percent respectively. The difference in altitude between any two points on the track shall not exceed one metre.

### 4 PREPARATION OF THE VEHICLE

**4.1** The vehicle shall conform in all its parts, components and systems to the technical specification declared by the manufacturer.

**4.2** In the case of commercial vehicles, either fully built vehicle or vehicle with cab and load body shall be tested.

**4.3** The vehicle shall be run-in as per the practice recommended by the manufacturer.

**4.4** The adjustments of fuel system, ignition system, grade, quality, quantity of lubricants for various moving parts, adjustments of brake, clutch, idling speed, etc, shall conform to the manufacturer's recommendation.

**4.5** The tyres shall be run in at the same time as the vehicle or shall have a tread depth not less than 90 percent of the tread depth of a new tyre and should have operated for at least 500 km or the distance recommended for the running-in of the vehicle, whichever is lower, on the road prior to the test.

**4.6** The tyre pressure shall be adjusted to the value specified by the manufacturer, when cold, and shall not be more than the maximum value specified in the relevant Indian Standard for that size of tyre.

**4.7** All the fuel enriching devices other than those required for the normal functioning of the vehicle shall be made inoperative.

**4.8** The vehicle shall be serviced before the test as per the procedure recommended by the manufacturer.

**4.9** Before the test, the vehicle including all its parts, components and systems shall have reached a stable temperature normal to the vehicle operation. The total distance of this run shall, however, be not less than 15 km and shall be carried out at a speed very close to the test speed.

#### 4.10 Accessories

4.10.1 All power consuming accessories and equipments such as lighting and illuminating devices, windshield wiper and washing system, record player, air climatizer, etc, shall be switched off. However, the drive for the air climatizer compressor shall not be disconnected.

4.10.2 In case, for reasons of safety during test, any of the lighting and illuminating devices are to be kept operative, a separate power source shall be used, which does not impose an extra load on the engine.

4.10.3 Where the power operated or power assisted devices have an integrally connected drive for devices such as power steering, power and vacuum assisted brakes, and similar feature required for the normal operation of the vehicle, these shall be kept operative.

4.10.4 If the radiator fan is temperature controlled, it shall be in the condition of normal operation of the vehicle.

4.10.5 All the windows and ventilating systems and latches of the vehicle shall be kept closed, except as required for the instrumentation purposes but test shall be kept to the minimum requirement.

#### 5 AMBIENT CONDITIONS

5.1 Standard reference conditions shall be as follows:

- a) Temperature : 300 K ( 27°C )
- b) Pressure : 100 kPa

5.2 The ambient conditions at the test site shall be:

- a) Temperature : 288 to 308 K  
( 15 to 35°C )
- b) Relative humidity: Not more than 75 percent
- c) Air density when calculated as described below shall not differ by more than 7.5 percent from the air density under the reference conditions:

$$d_t = \frac{d_o \times P_t \times T_o}{P_o \times T_t}$$

where

$d_t$  = Air density at test site expressed in kg m<sup>3</sup>,

$d_o$  = Air density at reference conditions = 1.168 kg/m<sup>3</sup>,

$P_t$  = Atmospheric pressure at test site in kPa,

$P_o$  = Atmospheric pressure at reference condition = 100 kPa,

$T_t$  = Ambient temperature at test site K, and

$T_o$  = Ambient temperature at reference condition = 300 K.

- d) The wind velocity in any direction shall not exceed 3 m/sec. The measurement of wind velocity shall be done at a height of 1 to 1.5 m above road surface.

#### 6 WEIGHTS

6.1 The unladen weight shall be the complete vehicle kerb weight as per IS 9211 : 1979, where applicable.

##### 6.2 Loading

The vehicle shall be loaded to a gross weight required for that particular test and shall be recorded in the test report.

6.3 The weight distribution between the axles shall be as recommended by the manufacturer and weight of any axle shall not be more than the maximum value recommended by the manufacturer.

6.4 The instruments, the testing personnel and other equipments necessary to be carried on the test vehicle at the time of test shall form part of the pay load and shall be recorded in the test report.

#### 7 INSTRUMENTATION

##### 7.1 General

Fitment and operation of all instruments shall be such as not to hamper the visibility or freedom of the driver to have proper control of the vehicle at all times. In addition, such fitment shall not unduly project out of the vehicle profile affecting the air drag or safety.

##### 7.2 Fuel

The fuel used for testing shall conform, unless otherwise stated, to Annex A or Annex B.

#### NOTES

1 Presently, petrol ( Motor gasoline ) conforming to IS 2796 : 1971 and diesel fuel conforming to IS 1460 : 1974 are commercially available. If these are used for testing purposes, their specific gravity shall be recorded.

2 If the vehicle fuel is anything other than petrol or diesel, the fuel used and its properties shall be recorded in the test report.

7.3 Suitable instruments to measure the following shall be used:

- a) Ambient pressure,

- b) Ambient temperature,
- c) Relative humidity, and
- d) Wind velocity.

#### 7.4 Fuel Measuring System

**7.4.1** The fuel measuring instrument shall be compatible with vehicle fuel system. The instrument used shall be a flowmeter working on the principle of positive displacement for sensing the flow.

**7.4.2** The fitment and operation of fuel measuring system shall be such that normal flow of the fuel to the engine is not hampered. The fuel tank shall be suitably vented to the atmosphere.

In the case of gravity fed petrol engine vehicle, the pressure head at the carburettor inlet shall not be more than the head corresponding to the condition of the vehicle when the fuel tank is filled to 90 percent capacity; and also this shall not be less than that corresponding to the near empty condition of the fuel tank to the extent possible.

**7.4.3** In the case of the vehicle with fuel return flow system, the return flow shall be cooled if necessary and processed so that, its temperature is very close to the temperature of the incoming fuel and is free of entrapped air or vapour bubbles.

#### 7.5 Distance

**7.5.1** The test may be conducted by the measurements being taken between two fixed points on the test track.

**7.5.2** The test may be conducted by measuring the actual distance travelled by vehicle during the test run by using instruments such as fifth wheel, contactless distance measuring systems, etc.

#### 7.6 Speed

There shall be a suitable speed indicating device to enable the driver to maintain the speed within the stipulated limit.

#### 7.7 Time

It shall be possible to measure the time taken for the vehicle to cover the measuring stretch.

#### 7.8 Fuel Temperature

Fuel temperature shall be measured at a point as close to the volumetric measurement of the fuel, as possible.

#### 7.9 Sensitivity

The operation of the instruments measuring the distance, time and the fuel quantity shall be synchronised within 0.2 sec.

#### 7.10 Accuracy and Least Count

The accuracies and least counts of the instruments used shall be as under:

	<i>Least Count not More Than</i>	<i>Error not More Than</i>
a) Fuel measurement	0.1 ml	± 1% of measured value
b) Distance	1 m	± 2 m
c) Time	0.1 sec	± 0.2 sec
d) Fuel temperature	1 K	± 2 K
e) Ambient temperature	1 K	± 2 K
f) Atmospheric pressure	1 mm of Hg	± 1 mm of Hg

#### 8 TEST

**8.1** The vehicle shall be tested at the constant speed/speeds required for the test.

**8.2** The vehicle shall be run in top gear or in the gear as recommended by the manufacturer.

Vehicles fitted with overdrive transmissions where overdrive limit engages automatically, shall be driven with the actuating switch in a position which ensures engagement when conditions of operation are reached.

Vehicles with automatic transmissions shall be driven in the drive ranges. Four wheel drive cross county vehicles shall be driven in the two wheel drive mode.

**8.3** During the test run the speed shall be maintained with  $\pm 1$  km/h of the mean speed by maintaining the accelerator control position as constant as possible. Any movement of the accelerator control required to hold the speed constant shall be smooth and gradual.

**8.4** The following shall be recorded:

- a) Volume of fuel consumed, ml ... Q
- b) Distance travelled, m ... S
- c) Time taken to cover the test distance, s ... t
- d) Fuel temperature, K ...  $T_f$
- e) Ambient temperature — Dry bulb, K ...  $T_{DB}$
- f) Ambient temperature — Wet bulb, K ...  $T_{WB}$
- g) Ambient pressure, kPa ...  $P_a$
- h) Wind velocity, in m/s
- j) Relative humidity, in %



The test shall be conducted over a distance of not less than 1 000 m. Two consecutive test runs in the opposite directions shall constitute a pass.

**8.5** The test shall be conducted sufficient number of times such that the readings for at least 5 passes ( one pass comprising consecutive readings in the opposite directions ), whose variation of  $S/Q_0$  for that pass is not more than  $\pm 2.5$  percent of mean and the average speed not varying by more than  $\pm 1$  km/h from the specified speed can be selected. These readings shall be selected such that the variation of  $S/Q_0$  is the minimum.

### 8.6 Calculation

**8.6.1** The quantity  $Q_0$  of fuel consumed per pass shall be calculated from the following relationship:

$$Q_0 = \frac{Q}{1 + 0.001 (T_f - 300)}$$

where  $T_f$  is the fuel temperature for that pass.

**8.6.2** The fuel consumption shall be calculated in km/litre as:

$$\text{Fuel consumption, km/litre} = \frac{S \times C}{Q_0}$$

where

$S$  = total distance covered in 5 passes,

$Q_0$  = total fuel oil mixture in case of lubricating oil is pre-mixed or fuel consumed in 5 passes corrected to the reference temperature,

$C$  = correction factor for mixing of lubricating oil in the fuel:

$$= 1 + \frac{V}{1000}$$

where

$V$  = volume of lubricating oil in ml mixed to one litre of fuel.

**8.6.3** The average speed shall be calculated as:

$$V = 3.6 \times \frac{S}{t} \quad \text{km/h}$$

whence

$t$  = total time taken for 5 passes.

## ANNEX A

( Clause 7.2 )

### SPECIFICATION OF REFERENCE PETROL

The reference fuel ( petrol ) shall meet the following requirements:

Characteristics	Limits	Method of Test ( Ref to Indian Standards )
1. Research octane number	87.0 Min	1448 ( Part 26 ) : 1960
2. Specific gravity at 288 K	0.73 - 0.75	1448 ( Part 16 ) : 1990
3. Reid vapour pressure, kg/cm <sup>2</sup>	0.45 - 0.65	1448 ( Part 39 ) : 1967
4. Distillation temperature, K		
Initial boiling point	298 - 318 K	
10 percent recovery	323 - 343 K	
50 percent recovery	358 - 378 K	
90 percent recovery	393 - 433 K	
Final boiling point	473 Max	
Residue, percent vol	2 Max	
5. Hydrocarbon analysis, percent vol		
Olefins	20 Max	1448 ( Part 23 ) : 1991
Aromatics	45 Max	
Saturates	Balance	
6. Oxidation stability, min	480 Min	1448 ( Part 28 ) : 1985
7. Existant gum, mg/100 ml	4.0 Max	1448 ( Part 29 ) : 1982
8. Sulphur content, percent by mass	0.10 Max	1448 ( Part 34 ) : 1979
9. Lead content, g/l	0.40 Max	1448 ( Part 38 ) : 1982 or 1448 ( Part 82 ) : 1974

## ANNEX B

( Clause 7.2 )

## SPECIFICATION OF REFERENCE DIESEL

The reference fuel ( diesel ) shall meet the following requirements:

<i>Characteristics</i>	<i>Limits</i>	<i>Method of Test ( Ref to Indian Standards )</i>
1. Specific gravity at 288 K	0.835 - 0.850	1448 ( Part 32 ) : 1972 or 1448 ( Part 16 ) : 1990
2. Cetane number or cetane Index	45 <i>Min</i>	1448 ( Part 9 ) : 1960
3. Distillation, K		
50 percent vol recovery	518 <i>Min</i>	1448 ( Part 18 ) : 1991
90 percent vol recovery	583 - 613	
Final boiling point	643 <i>Max</i>	
4. Kinematic viscosity cSt at 313 K	2.5 - 4.0	1448 ( Part 25 ) : 1976
5. Sulphur content, percent by mass	0.3 - 0.5	1448 ( Part 33 ) : 1991
6. Flash point, K	305 <i>Min</i>	1448 ( Part 20 ) : 1982
7. Pour point, K	279 <i>Max</i>	1448 ( Part 10 ) : 1970
8. Conradson carbon residue on 10 percent residuum, percent by mass	0.20 <i>Max</i>	1448 ( Part 8 ) : 1967
9. Ash content, percent by mass	0.01 <i>Max</i>	1448 ( Part 4 ) : 1984
10. Water content, percent by mass	0.05 <i>Max</i>	1448 ( Part 40 ) : 1987
11. Copper corrosion 373 K	1 <i>Max</i>	1448 ( Part 15 ) : 1976
12. Acidity, total, in terms of mg of KOH/g	0.50	1448 ( Part 2 ) : 1967

ANNEX C  
( Foreword )

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Sectional Committee, TED 8

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