

*भारतीय मानक प्रारूप*

**मोटर वाहनों के गुरुत्वाकर्षण केंद्र के निर्धारण की विधि**

*Draft Indian Standard*

**METHOD OF DETERMINATION OF CENTRE OF GRAVITY OF AUTOMOTIVE  
VEHICLES**

ICS: 43.020

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Automotive Braking Systems, Vehicle Testing, Steering and performance Evaluation Sectional Committee, TED 4

## FOREWORD

This Indian Standard will be adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Suspension and Steering Systems Sectional Committee had been approved by Transport Engineering Division Council.

This standard was first published in 1995 to specify procedure for determining the position and the height of centre of gravity (CG) of vehicles of categories M and N. This revision has been undertaken to in view of latest technological advancement which have taken place after the publication of the standard. In this revision the amendment 1 has been incorporated and the references have been updated.

The overall performance of an automotive vehicle is a function of performance of its various components, systems, weight distribution over the axles, loading pattern etc. For the stability of the vehicle and to decide loading pattern of the vehicle, the height and position of centre of gravity of the vehicle plays an important role.

This standard contains technical requirements for determining the height and position of centre of gravity of automotive vehicles so that the procedure is applied uniformly basis by all concerned.

The composition of the committee responsible for formulation of this standard is given as **Annex A** (Will be added later)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Draft Indian Standard***METHOD OF DETERMINATION OF CENTRE OF GRAVITY OF AUTOMOTIVE VEHICLES****1 SCOPE**

This standard prescribes the procedure for determining the position and the height of centre of gravity (CG) of vehicles of categories M and N.

**2 REFERENCES**

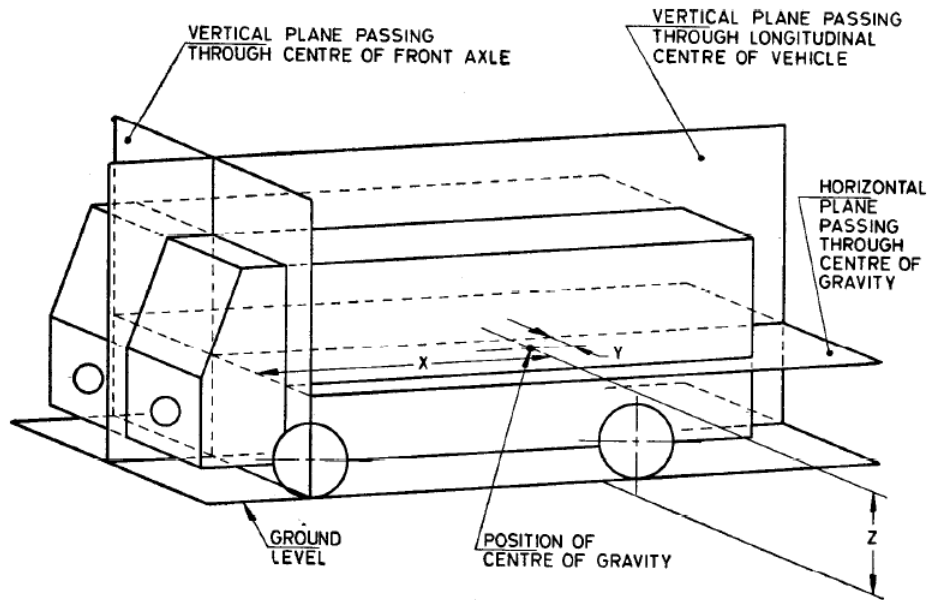
The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 9211: 2003	Terms and definitions of weights of road vehicles other than 2 and 3 wheelers (Second Revision)
IS 14272: 2011	Automotive vehicles – Types – Terminology

**3 TERMS AND DEFINITIONS APPLY**

For the purpose of this standard the following terms and definitions shall apply:

**3.1 Height of Centre of Gravity** — It is the height of centre of gravity from the supporting surface when the vehicle is placed on a plain level horizontal surface. This is shown as 'Z' in Fig. 1.



$X$  = Distance of CG from Front Axle  
 $Y$  = Distance of CG from Centre Line  
 $Z$  = Height of CG

FIG. 1 CENTRE OF GRAVITY

**3.2 Position of Centre of Gravity** — The position of centre of gravity on a horizontal plane shall be defined on the longitudinal axis and on the transverse axis as follows (*see* Fig. 1).

**3.2.1** Position of centre of gravity along with the longitudinal axis is defined as the least distance of centre of gravity from a transverse vertical plane passing through the centre line of the front axle of the vehicle. This is shown as 'X' in Fig. 1.

**3.2.2** Position of centre of gravity along transverse axis of the vehicle is defined as the least distance of centre of gravity from a vertical plane passing through the longitudinal centre line of the vehicle. This position of centre of gravity may be on left hand side or right hand side of the vertical plane. Left hand and right hand sides are with reference to driver when seated in the driving seat.

#### 4 PREPARATION OF THE VEHICLE

**4.1** The vehicle shall conform in all its parts and components to the design and/or production series as applicable.

**4.2** The tyres fitted on the vehicle shall not have done more than 10 percent of its life and shall be inflated to the pressure recommended by the vehicle manufacturer. Tread depth measurement may be used to assess the tyre life.

**4.3** The vehicle loading shall be as per the vehicle kerb weight as defined in IS 9211.

**4.4** All axle suspensions of the vehicle shall be blocked by some means so that its springs do not get deflected during the tests.

## 5 TEST PROCEDURE

**5.1** The front and rear axles of the test vehicle shall be weighed separately. The least count of the weighing bridge shall be 1 percent of the measured value. These weights shall be denoted as  $W_1$  and  $W_2$ . Then total weight of the test vehicle shall be taken and this shall be denoted as 'W'. The wheel base of the two axled test vehicle from both the sides shall be measured. This shall be denoted as  $l_1$  and  $l_2$ . In case of the test vehicle having more than two axles, the wheel base of the test vehicle shall be mean centre of the rear axles and front axle. The mean value of wheel base shall be denoted by  $L$  which is  $L = \frac{l_1+l_2}{2}$ .

**5.1.1** Similarly the mean value of front and rear track width shall be obtained by the formula:

$$a = \frac{a_1+a_2}{2}$$

where

$a$  = mean value of front and rear track width;

$a_1$  = width of front track; and

$a_2$  = width of rear track.

**5.1.2** Then the test vehicle shall be placed on the weighing platform such that front axle wheels (or rear axle wheels) shall be on the weighing platform and other axle wheels shall remain outside on the same level. This weight shall be denoted by  $W_3$ . The parking brake of the vehicle shall be applied and engine shall be switched off. Then the wheels which are outside the weighing platform shall be lifted through certain height. Then the height of centre of lifted wheels from ground level shall be measured and denoted by 'Y'.

**5.1.3** The weight of the wheels which are on the weighing platform shall be measured and shall be denoted as ' $W_4$ '. Then the vehicle shall be brought to its original position. The right side and left side weights of the vehicle shall be taken and denoted as ' $W_5$ ' and ' $W_6$ '. The rolling radius of the wheels of the test vehicle shall be measured as per **5.1.4** and shall be denoted as ' $r$ '. The height of the centre of gravity and its position shall be worked out from the formula given below:

a)	Height of Centre of gravity (Z) =	$r + \frac{L(W_4 - W_3)\sqrt{L^2 - (Y-r)^2}}{W.(Y-r)}$
b)	Position of Centre of gravity along longitudinal axis (X) =	$\frac{W_2 \times L}{W}$ from front axle (when rear axle is lifted)
c)	Position of Centre of gravity along transverse axis (Y) =	$a \left( \frac{W_6}{W} - \frac{1}{2} \right)$ towards right hand side;  <i>or</i>  $a \left( \frac{W_5}{W} - \frac{1}{2} \right)$ towards left hand side.

**5.1.4 Procedure for Measuring Rolling Radius** — Keeping the vehicle on level ground the contact points of front or rear tyres shall be marked with chalk both on the ground and on the tyre. The vehicle shall be stopped after five revolutions of the tyre when the chalk mark on the tyre comes in contact with the ground and this point on the ground shall be marked. The distance between the initial and final positions on the ground shall be measured and the rolling radius shall be calculated as follows:

$$\text{Rolling radius } (r) = \frac{\text{Measured distance}}{10 \pi}$$

**ANNEX A**  
*(Foreword)*

**COMMITTEE COMPOSITION**

AUTOMOTIVE BRAKING SYSTEMS, VEHICLE TESTING, STEERING AND  
PERFORMANCE EVALUATION SECTIONAL COMMITTEE, TED 4

**(Will be added later)**