International Standard 4182

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Motor vehicles — Measurement of variations in dipped-beam headlamp angle as a function of load

Automobiles — Mesurage des variations d'inclinaison du faisceau de croisement en fonction de la charge

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4182 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 4182-1979), clause A.4.2 of annex A of which has been technically revised.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Motor vehicles — Measurement of variations in dipped-beam headlamp angle as a function of load

1 Scope

This International Standard specifies a method of measuring variations in the dipped-beam headlamp angle of motor vehicles from the initial angle, caused by changes in vehicle attitude due to loading. This measurement method may be used particularly during vehicle type approval tests.

Loading conditions of vehicles are specified in annex A. They are to be used except when legal regulations require different loading conditions.

Annex B establishes a classification of headlamps, and gives examples of measurement methods applicable according to the classification. Annex C gives a photometric method of determining the position of a point of the conventional cut-off, which is complementary to one of the measurement method examples in annex B.

2 Field of application

This International Standard applies to motor vehicles as defined in ISO 3833.

3 References

ISO 303, *Road vehicles — Installation of lighting and signalling devices for motor vehicles and their trailers.*

ISO 612, *Road vehicles — Dimensions of motor vehicles and towed vehicles — Terms and definitions.*

ISO 3833, *Road vehicles — Types — Terms and definitions.*

CEE Directive 76/756, *Installation of lighting and light signalling devices on motor vehicles and trailers.*

4 Definitions

4.1 Classification

In this International Standard, vehicles defined in ISO 3833 are classified as follows.

4.1.1 vehicle, category M : Motor vehicle intended for transporting people.

4.1.1.1 vehicle, category M_1 : Motor vehicle, category M (4.1.1), containing not more than eight seats, in addition to the driver's seat.

4.1.1.2 vehicle, category M_2 : Motor vehicle, category M (4.1.1), containing more than eight seats, in addition to the driver's seat, and having a maximum permissible mass not exceeding 5 t.

4.1.1.3 vehicle, category M_3 : Motor vehicle, category M (4.1.1), containing more than eight seats, in addition to the driver's seat, and having a maximum permissible mass exceeding 5 t.

4.1.2 vehicle, category N : Motor vehicle intended for transporting goods.

4.2 Type of vehicle

For the purposes of this International Standard, vehicles shall be considered to be of the same type if they do not differ in such essential respects as :

— wheel-base (wheel space) (see definitions in ISO 612);

— location of headlamps on the motor vehicle;

— headlamp class (see annex B);

— characteristics of the suspension system;

— axle loads stated by the manufacturer;

— means used to correct dipped-beam angle according to load.

4.3 Initial angle

4.3.1 stated initial angle : Value of the dipped-beam initial angle specified by the motor vehicle manufacturer.

It serves as a reference value for the calculation of permissible variation.

4.3.2 measured initial angle : Mean value of dipped-beam angle or vehicle angle measured with the vehicle in condition No. 1 as defined in annex A for the category of vehicle under test.

It serves as a reference value for the assessment of variation in dipped-beam angle as the load changes.

4.4 dipped-beam angle : Angle may be defined :

— either as the angle, expressed in milliradians, between the direction of a characteristic point in the luminous spread of the headlamp and the horizontal plane;

— or by the tangent of that angle, expressed in percent, since the angles are small (for these small angles, 1 % is equal to 10 mrad).

If the angle is expressed in percent, it can be calculated by the formula

$$\frac{h_1 - h_2}{l} \times 100$$

where

h_1 is the height above the ground, in millimetres, of a characteristic point in the luminous spread of the headlamp, measured on a vertical screen perpendicular to the vehicle longitudinal median plane, placed at a horizontal distance l;

h_2 is the height, in millimetres, of the reference centre (4.5) above the ground;

l is the distance, in millimetres, from the screen to the reference centre (4.5).

Negative values denote downward angle (see figure 1). Positive values denote upward angle.

4.5 reference centre : Reference centre indicated by the headlamp manufacturer.

5 Measurement conditions

5.1 If visual inspection of the dipped-beam pattern on the screen or a photometric method is used, measurements shall be carried out in a dark place (for example a dark room) big enough to allow the vehicle and screen to be placed as shown in figure 1.

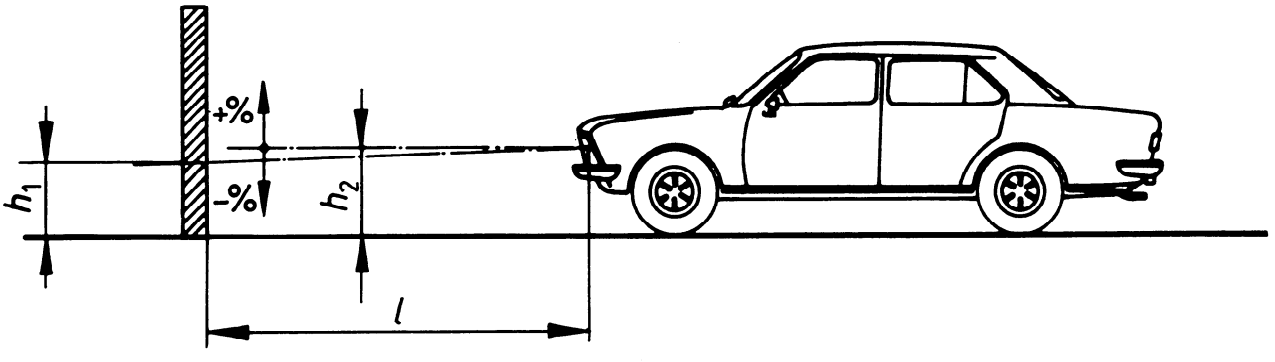
Headlamp reference centres (4.5) shall be at a distance l from the screen of at least 10 m.

5.2 Vehicle and screen shall be located in such a way that the requirements given in 5.2.1 and 5.2.2 are met.

5.2.1 The ground on which measurements are made shall be as flat and horizontal as possible, so that the reproducibility of measurements of dipped-beam angle can be ensured to an accuracy of ± 0,5 mrad (± 0,05 % angle).

5.2.2 If a screen is used, its marking, position and orientation with respect to the ground and the median longitudinal plane of the vehicle shall be such that the reproducibility of measurements of beam angle can be ensured to an accuracy of ± 0,5 mrad (± 0,05 % angle).

5.3 During measurements, the ambient temperature shall be within 10 to 30 °C.



NOTES

1 This drawing represents a passenger car of category M_1 but the principle shown applies equally to a vehicle of another category.

2 Where the vehicle does not incorporate a headlamp-levelling device, the variation in dipped-beam angle is identical to the variation of the angle of the vehicle itself and can be derived from this (see annex B).

Figure 1 — Dipped-beam downward angle for a passenger car

6 Vehicle preparation

6.1 Measurements shall be carried out on a vehicle which has travelled a distance of 1 000 to 10 000 km, and preferably about 5 000 km.

6.2 Tyres shall be inflated to the full-load pressure specified by the manufacturer. The vehicle shall be fully replenished (fuel, water, oil) and equipped with all accessories and tools specified by the manufacturer.

NOTE — Full fuel replenishment means that the fuel tank is filled to not less than 90 % of its capacity.

6.3 The vehicle shall have the parking brake released and the gear-box in neutral.

6.4 The vehicle shall be conditioned for at least 8 h at the temperature specified in 5.3.

6.5 If a photometric or visual method is used, and if the vehicle is equipped with cut-off type headlamps, headlamps with a well-defined dipped-beam cut-off should be chosen and installed on the vehicle under test, in order to facilitate the measurements.

For special preparations, see annex B.

When so agreed between the vehicle manufacturer and the test laboratory, other means are allowed to obtain a more precise reading (for example removal of headlamp lens).

7 Test procedure

7.1 General

The variations in dipped-beam angle or the variations in vehicle angle, according to the method chosen, shall be measured separately for each side of the vehicle. The results obtained on both left and right headlamps, under all load conditions specified in annex A, shall be within the limits set in 7.5. The load shall be applied gradually, without subjecting the vehicle to excessive shocks.

7.2 Determination of the measured initial angle

The vehicle shall meet the conditions specified in clause 6 and be laden as specified in annex A in the first clause of the appropriate vehicle category.

Before each measurement, the vehicle shall be rocked as specified in 7.4. Measurements shall be taken three times.

7.2.1 If none of the three measured results differs by more than 2 mrad (0,2 % angle) from the arithmetic mean of the results, that mean shall constitute the final result.

7.2.2 If, for any measurement, this difference is greater than 2 mrad (0,2 % angle) from the arithmetic mean of the results, a further series of 10 measurements shall be made.

The arithmetic mean of these 10 new measurements shall constitute the final result.

7.3 Measurement methods

Depending on the headlamp class as defined in annex B, various measurement methods are applicable, provided that the readings are within an accuracy of ± 0,2 mrad (± 0,02 % angle).

Examples of measurement methods are given in annex B; other alternative methods are allowed provided that they give equivalent results.

7.4 Treatment of vehicle after load variation

After each load variation, the vehicle suspension and any other parts likely to affect dipped-beam angle shall be worked, in accordance with the methods described in 7.4.1 to 7.4.3.

However, in agreement with the test laboratories, manufacturers may offer other methods (either experimental or based upon calculations), especially when experiment presents special difficulties and when such calculations are clearly valid.

7.4.1 M_1 category vehicles with conventional suspension

With the vehicle standing on the measuring site and, if necessary, with the wheels resting on floating platforms[1] (which may be used only if their absence would restrict suspension movement, thereby influencing the measurement results), rock the body lengthwise as follows :

Rock the vehicle continuously for at least three complete cycles, each cycle consisting in pushing down first the rear end and then the front end of the vehicle.

The rocking sequence shall end with the completion of a cycle. Before taking the measurements, wait until the vehicle comes to rest unaided.

7.4.2 M_2, M_3 and N category vehicles with conventional suspension

With the vehicle standing on the measuring site and the wheels on the ground, rock the body by varying the load for an instant.

7.4.3 Vehicles with non-conventional suspension requiring the engine to be run (for example hydraulic or pneumatic)

Use the following procedure, modified, if necessary, according to the manufacturer's specifications :

a) Adjust the engine speed to meet the manufacturer's specifications.

b) If necessary, provide additional engine cooling.

1) Obtained by placing metal balls between the bottom plate on the ground and the top plate supporting the wheels.

c) After each change in load before taking any measurement, wait, if necessary, until the vehicle has stabilized.

d) Since tests are conducted in the laboratory, make sure that the air pipe from the exhaust pipe to the outside does not impede movement of the vehicle or taking of measurements.

7.5 Measurements

The variation in angle of the dipped-beam shall be assessed for each of the different load conditions in relation to the initial angle determined in accordance with 7.2. When the vehicle is equipped with a manual headlamp-levelling system, this shall be adjusted to the positions specified by the manufacturer for given load conditions.

7.5.1 In the first instance, a single measurement shall be made for each load condition. If, for all the load conditions, the variation in angle is within the calculated limits (for example within the difference between the stated initial angle and the lower and upper limits specified for approval) with a safety margin of 4 mrad (0,4 % angle), compliance is accepted.

7.5.2 If the result(s) of any measurement(s) do not respect the safety margin given in 7.5.1 or exceed the limit values, a further three measurements shall be taken in the loading conditions corresponding to these results, as indicated in 7.5.3.

7.5.3 For each of these loading conditions :

a) If none of the three results measured differs by more than 2 mrad (0,2 % angle) from the arithmetic mean of the results, that mean shall constitute the final result.

b) If, for any measurement, this difference is greater than 2 mrad (0,2 % angle) from the arithmetic mean of the results, a further series of 10 measurements shall be taken, the arithmetic mean of which shall constitute the final result.

c) In the case of a vehicle equipped with an automatic headlamp-correcting system which has an inherent hysteresis loop, average results at the top and bottom of the hysteresis loop respectively shall be taken as relevant values.

All these measurements shall be taken in accordance with 7.5.3 a) and 7.5.3 b).

7.5.4 If, under all load conditions, the variation so obtained between the measured initial angle determined in accordance with 7.2 and the angle measured under each load condition is less than the values calculated in 7.5.1 (without safety margin), compliance is accepted.

7.5.5 If only one of the calculated upper or lower limits of variation is exceeded, the manufacturer shall be permitted to choose, within the limits specified for approval, a different value for the stated initial angle.

Annex A

Loading conditions for the different vehicle categories

(This annex forms an integral part of the Standard.)

A.1 General

For the tests described in A.3 to A.6, each of the seats (fixed, folding or removable) to be considered in the various load conditions shall be loaded with a mass of 75 kg simulating the passenger and his hand luggage.

A.2 Load conditions

Variations of dipped-beam angle caused by changes in vehicle attitude due to load shall be measured under the following load conditions.

A.3 M_1 category vehicles

A.3.1 Condition No. 1

One occupant in the driver's seat.

A.3.2 Condition No. 2

Driver, plus one occupant in the front seat furthest from the driver's seat.

A.3.3 Condition No. 3

Driver, plus one occupant in the front seat furthest from the driver's seat, plus occupants in all the rearmost seats.

A.3.4 Condition No. 4

Occupants in all seats.

A.3.5 Condition No. 5

Occupants in all seats, plus balanced loading of boot or luggage compartment (or of station wagon load deck) so as to obtain the maximum permissible load on rear or front axle, depending on whether the boot is at the rear or the front.

Should the vehicle be equipped with one front and one rear boot or luggage compartment, the additional load shall be uniformly distributed so that the maximum axle load requirements are met; however, if the total maximum permissible load is attained before the maximum permissible load on one of the two axles is reached, then the loading of the luggage compartment(s) shall be limited to the value giving the total load.

NOTE — In determining the above loading conditions, account must be taken of any loading restrictions laid down by the manufacturer.

A.4 M_2 and M_3 category vehicles

A.4.1 Condition No. 1

One occupant in the driver's seat.

A.4.2 Condition No. 2

Vehicles laden such that each axle carries its maximum technically permissible load, or until the maximum permissible mass of the vehicle is attained by loading the front and rear axles proportionally to their maximum technically permissible loads, whichever occurs first.

A.5 N category vehicles with load platform

A.5.1 Condition No. 1

One occupant in the driver's seat.

A.5.2 Condition No. 2

Driver, plus a load so distributed as to give the maximum technically permissible load on the rear axle or axles, or the maximum permissible mass of the vehicle, whichever occurs first, without exceeding a front axle load calculated as the sum of the front axle load of the unladen vehicle plus 25 % of the maximum permissible payload on the front axle. Conversely, the front axle is so considered when the load platform is at the front.

A.6 N category vehicle without load platform

A.6.1 Towing trucks for semi-trailers

A.6.1.1 Condition No. 1

One occupant in the driver's seat, with no load on the fifth wheel.

A.6.1.2 Condition No. 2

Driver, plus the maximum technically permissible load on the fifth wheel, in the fifth wheel location corresponding to the maximum load on the rear axle.

A.6.2 Towing trucks for trailers

A.6.2.1 Condition No. 1

One occupant in the driver's seat.

A.6.2.2 Condition No. 2

Driver, plus occupants in all other seating positions in the cab.

Annex B

Headlamp classification and examples of measurement methods

B.0 Introduction

Examples are given in B.2 of different methods of assessing the variation in dipped-beam angle. However, some of these methods are not applicable to vehicles with certain types of headlamp installation. For the purposes of this annex, therefore, headlamps are considered to belong to one of three classes, as defined in B.1; applicable measurement methods are indicated for each class of headlamp.

B.1 Applicable methods

B.1.1 Class I

Headlamps which are fixed rigidly to the vehicle frame or bodywork, and in which the optical elements do not move to compensate for changes in vehicle loading.

NOTE — Semi-fixed aiming devices (for initial aim setting) and mechanisms for headlamp concealment are both considered as rigidly fixed.

Applicable methods : B.2.1 a) or B.2.1 b)
B.2.2 a) or B.2.2 b)
B.2.3 a) or B.2.3 b)

B.1.2 Class II

Headlamps which are re-settable (manually or automatically) with respect to the vehicle frame or bodywork as a function of changes in vehicle loading.

Applicable methods : B.2.1 a) or B.2.1 b)
B.2.2 a) or B.2.2 b)

B.1.3 Class III

Headlamps in which the lens is rigidly fixed to the vehicle frame or bodywork, but in which the reflector or other optical elements are re-settable (manually or automatically) as a function of changes in vehicle loading.

Applicable methods : B.2.1 a) or B.2.1 b)

B.2 Measurement methods

NOTE — The examples given in B.2.1 to B.2.3 are not intended to provide a comprehensive list : other suitable methods may be used by agreement with the test laboratory.

B.2.1 Direct measurement of dipped-beam angle

The dipped-beam shall be projected on to a screen. The distance l from the screen to the reference centre of the headlamp shall be not less than 10 m. All measurements of angle and variation shall be taken from a chosen characteristic point in the dipped-beam pattern. The lens may be masked partially to increase the sharpness of the beam pattern on the screen. If the dipped-beam pattern has a well-defined horizontal cut-off, a characteristic point shall be chosen which is on a suitably central part of the horizontal cut-off line. For European-type headlamps, this part of the horizontal cut-off is contained between two vertical lines traced on the screen, passing through the points HV and B50 L (or B50 R, as appropriate) (see CEE Directive 76/756).

B.2.1.1 Method a) : Direct measurement, by visual inspection of the chosen characteristic point

Variations in the height above the ground of the characteristic point may be measured directly, for example by reference to suitable graduations marked on the screen.

B.2.1.2 Method b) : Direct measurement by photometric means

The position of the characteristic point, and the variations in its height above the ground, may be determined by a photometric method such as that described in annex C. In this case, the electrical supply to the headlamps shall be stabilized.

B.2.2 Measurement of headlamp orientation in the vertical plane

B.2.2.1 Method a) : Measurement by laser and mirror

A plane mirror, of good optical quality and with the reflective coating on its exposed surface, shall be mounted in the centre of the headlamp lens. Use of a helium-neon (He-Ne) laser is recommended. The distances from the laser to the mirror and from the mirror to the measuring point shall be greater than 3 m. Unless the optical layout is so arranged that both the incident and the reflected rays are substantially horizontal, a correction will be necessary to compensate for vertical displacements of the headlamp due to changes in vehicle loading.

B.2.2.2 Method b) : Measurement by inclinometer

A suitable inclinometer, which may be one of the following types, shall be connected directly to the headlamp :

- electronic;
- bubble level, with vernier.

B.2.3 Measurement of vehicle attitude

B.2.3.1 Method a) : Direct measurement of vehicle height

Two reference points shall be chosen, on the same side of the vehicle. The horizontal distance between the two points shall be at least 70 % of the vehicle overall length.

Both points shall lie in a horizontal plane at a height above the ground of between 80 and 120 % of the height above the ground of the headlamp reference centre.

B.2.3.2 Method b) : Measurement by inclinometer

The inclinometer shall be attached securely to a suitably rigid part of the vehicle frame or bodywork.