INTERNATIONAL STANDARD

ISO 5006-1

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Earth-moving machinery — Operator's field of view —

Part 1: Test method

Engins de terrassement — Visibilité du conducteur —

Partie 1: Méthode d'essai

Reference number
ISO 5006-1:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5006-1 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Sub-Committee SC 1, *Test methods relating to machine performance*.

ISO 5006 consists of the following parts, under the general title *Earth-moving machinery — Operator's field of view*:

— *Part 1: Test method*

— *Part 2: Evaluation method*

— *Part 3: Criteria*

Annex A forms an integral part of this part of ISO 5006.

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Introduction

The purpose of this test method is to allow the determination of the maskings that are caused by various parts of the machine on a visibility test circle around the machine from a point which simulates the eye position of the 50th percentile earth-moving machinery operator. An evaluation method will be given in ISO 5006-2 and criteria for machinery in ISO 5006-3.

The visibility test circle selected is one of 12 m radius on the test surface with its centre at the eye position point. For the sector of vision and the visual field, an arc on the test surface with a radius of 19 m with its centre at the filament position centre is used to determine the maskings at the greater radius.

The test method recognizes the effect of the operator being able to move the eye position in the head and the head position in the operator's station. This results in the use of a filament spacing of up to 405 mm in the sector and field of vision and a filament spacing of 205 mm in the field of view. The nominal eye spacing of 65 mm is used for the basic filament spacing.

Rationale for Part 1

There is a need to quantify the ability of the earth-moving machinery operator to view the areas around the machine considering specific machine design, function and operation. This part of ISO 5006 provides a test method which will allow users to quantify the visibility which is possible with current machines.

A circular visibility area with a 12 m radius on the test surface was chosen because it is practical from a test facility viewpoint. It represents typical road dimensions in urban areas, and it presents the ability to observe sufficient near-field visibility conditions to be useful in machinery design.

The light-bulb filament locations were determined based on the eye positions of the 50th percentile earth-moving machinery operator. The filament spacing was based on the typical binocular eye spacing of operators. The secondary filament spacings took into account the ability of the operator to rotate the eyes within the head, the head position on the upper torso and to rotate the upper torso while using a conventional seat-belt.

The area around the machine is divided into four specific areas. The area to the front is the sector in which visibility is required for straight ahead travel. It is the smallest sector because at higher travel speeds the viewing distance is usually great and thus the actual chord length of view is substantial.

The second visibility test area is that to the front outside of the sector of vision. Visibility in this area is for low-speed travel or use of the ma-

chine because it requires that steering action be used to move to either the left or right parts of this area.

The third visibility test area is to the rear left and right areas. This is essentially the same as the above except that the machine is in reverse travel. The secondary filament spacing is less for this area because eye position is limited if only the upper torso rotates.

The fourth area is a straight back area. It has a larger chord length because of the slower speed for reverse movement so that a wider visual field is needed to provide visibility for the operator. Only primary filament spacing is used because of the limitations on the operator's ability to move.

Specific machine set-up conditions are provided because the arrangement and positioning of the machine and its equipment directly influence the maskings which could exist.

Earth-moving machinery — Operator's field of view —

Part 1:
Test method

1 Scope

This part of ISO 5006 specifies a stationary test method for determining the masking effect caused by parts of the base machine with equipment as specified by the manufacturer on a visibility test circle around the machine from the eye position point of a seated operator. It applies to earth-moving machinery which has a specific seated operator's position and which operates on work-sites or travels on public roads.

ISO 5006 does not cover visibility tests during operational movement of working tools.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 5006. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 5006 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3411:1982, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope.*

ISO 5353:1978, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point.*

3 Definitions

For the purposes of ISO 5006, the following definitions apply.

3.1 filament position centre-point: Point located 660 mm above and 20 mm in front of the seat index point as defined by ISO 5353. This represents the eye position point of the 50th percentile world-wide male operator (see ISO 3411). Available seat adjustment range accounts for the 5th to 95th percentile operator. (See figure 1.)

3.2 visibility test circle: Circle with 12 m radius on a horizontal surface with its centre at the filament position centre, unless otherwise specified.

3.3 sector of vision: Segment of the visibility test circle to the front of the machine established by a 9,5 m chord which is perpendicular to the longitudinal plane passing through the filament position centre-point with the chord length bisected by the longitudinal plane. (See figure 2.)

3.4 field of vision: Segments of the visibility test circle to the front of the machine outside the sector of vision and bounded by the transverse plane through the filament centre-point. (See figure 2.)

3.5 visual field: Segment of the visibility test circle to the rear defined by an angle of 45° to both the right and left sides of the longitudinal plane passing through the filament centre-point. (See figure 2.)

3.6 field of view: Segments of the visibility test circle to the rear between the visual field and the fields of vision. (See figure 2.)

3.7 masking effect: Segments of the visibility test circle on which a shadow is created because a part(s) of the base machine and/or its equipment block(s) the light rays from both of the filaments. For

example masking could be caused by ROPS[1], window and door frames, exhaust pipes, the hood and equipment components such as bucket, boom, etc.

4 Test apparatus

4.1 Light source consisting of two halogen bulbs (or equivalent) mounted with the filaments vertical. The fixture shall be such that the mid-point of the filaments is at the height of the filament position centre-point defined in 3.1. Each filament should be horizontally movable from 32,5 mm up to 202,5 mm on each side of the filament position centre-point, and rotatable. (See figure 1.)

4.2 Test surface, an area of compacted earth or paved surface which has no more than 3 % gradient in any direction.

5 Machine test configuration

5.1 The machine shall be equipped according to the manufacturer's specification.

5.2 All machine openings such as doors and windows shall be closed.

5.3 The machine shall be set up according to the specific information given in annex A for each type of machine.

6 Measurement procedure

6.1 Machine and filament placement

6.1.1 Place the machine on the test surface and mark the 12 m radius visibility test circle on the test surface. A 19 m radius arc may be required for the sector of vision and visual field if the maskings exceed the 12 m radius arc in these sectors when tested in accordance with 6.2.4.

The filament position centre-point defined in 3.1 shall be vertically above the visibility circle centre-point.

6.1.2 Mount the filaments so that they are equally spaced around the filament position centre-point defined in 3.1.

6.1.3 To take measurements, rotate the light bar so that the line between the filaments is perpendicular to the line between the filament position centre-point defined in 3.1 and the centre of the visibility blockage component.

1) Roll-over protective structure.

6.2 Determination of maskings

6.2.1 Place the light-bulbs so that they are 32,5 mm either side of the filament centre-point defined in 3.1. Rotate the light bar for one revolution and record the masking effect of each visibility blockage created on the visibility test circle. Measure the maskings in millimetres as a chord-length.

NOTE 1 The test can be carried out in a dark environment where the masking effects can be directly noted on the visibility test circle, or a mirror located on the test surface can be used to develop a line of sight to the filament to determine the point on the visibility test circle where masking occurs.

6.2.2 If maskings are recorded in the sectors of vision and field of vision, conduct a second test with the filament spacing up to 202,5 mm to either side of the filament centre-point.

Record the remaining masking effect, if any, on the visibility test circle.

6.2.3 If maskings are recorded in the field of view, carry out a second test with the filament spacing up to 102,5 mm to either side of the filament centre-point.

Record the remaining masking effect, if any, on the visibility test circle.

6.2.4 If maskings are recorded in the sector of vision and visual field, carry out a second test with the radius of the visibility test circle increased to 19 m. The maximum filament spacing to either side of the filament centre-point shall be 202,5 mm for the sector of vision and 32,5 mm for the visual field. Rotate the light bar through the visual field and record the maskings on the visibility test circle, if any.

7 Calculation procedure for determination of maskings

The calculation procedure provides an alternative to the test method. (See figure 3.)

For binocular vision with an eye spacing of s, the masking, expressed in millimetres, is given by the equation

$$x = \left(\frac{b - s}{a} \right) r + s$$

where

a is the distance between the component causing the masking and the filament, in millimetres;

b is the width of the component causing the maskings measured horizontally, and perpendicular to the radius from the filament position centre-point and the centre of the component, in millimetres;

r is the radius from the filament centre-point on the test surface to the visibility test circle on the test surface, in millimetres;

s is the distance between the filaments, used to represent binocular vision with this eye spacing, in millimetres;

x is the width of the masking tangent to the visibility test circle, in millimetres.

NOTE 2 This equation is an approximate calculation of the masking and becomes less accurate as the length of the masking increases.

8 Test report

The test report shall include the information indicated in 8.1 and 8.2.

8.1 Machine details

a) manufacturer;

b) model;

c) machine mass or rated pay-load;

d) serial number;

e) operator enclosure and/or ROPS description or identification;

f) equipment installed on the machine;

g) any other information which affects the masking measurements.

8.2 Drawing

The drawing shall show the maskings (dimensions in millimetres) on the visibility test circle by the designated visibility test area with the specific filament spacing. The distance between maskings and also the distance from the end of the specific visibility test area shall be provided (see figure 4 for an example). In lieu of a drawing, a tabulation can also be provided if it gives the required information.

Dimensions in millimetres

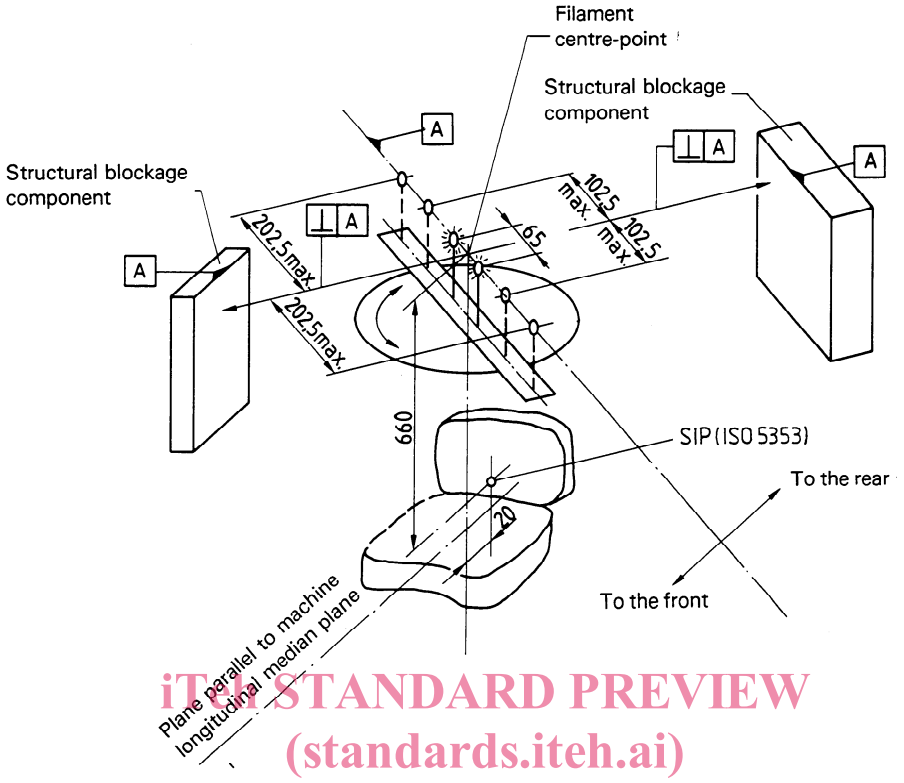


Figure 1 — Arrangement of test equipment (see clause 4)

Dimensions in metres

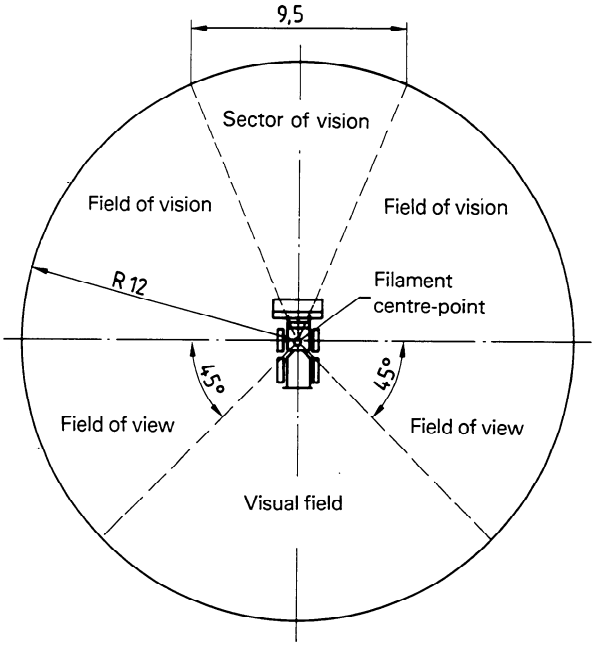
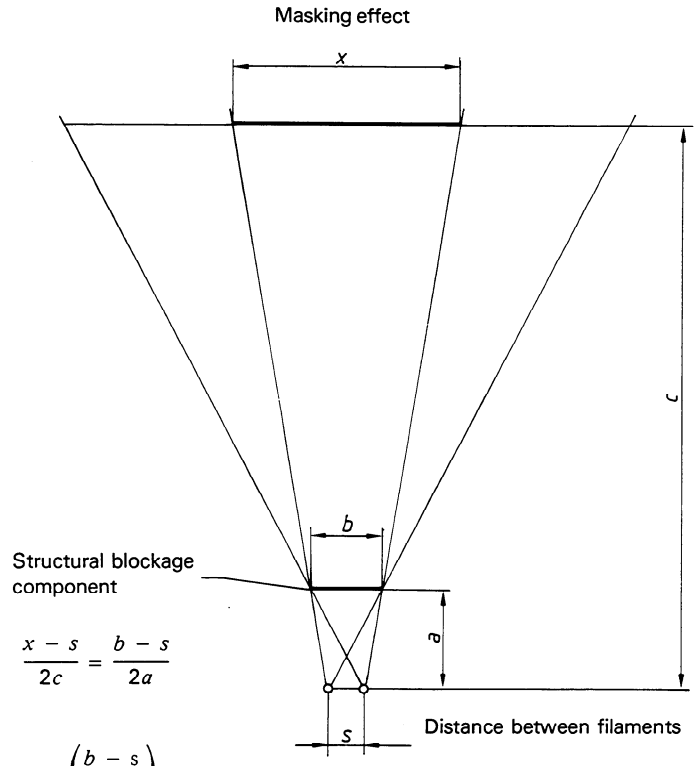


Figure 2 — Definition of visibility test areas (see clause 3)



$$\frac{x - s}{2c} = \frac{b - s}{2a}$$

$$x = \left(\frac{b - s}{a}\right) c + s$$

Figure 3 — Mathematical determination of masking effects (see clause 7)