
International Standard



5721

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Agricultural tractors — Operator's field of vision

Tracteurs agricoles — Champ de visibilité du conducteur

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Descriptors : agricultural machinery, tractors, operating stations, human factors engineering, field of visibility, position, eyes, tests.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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.

International Standard ISO 5721 was developed by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, and was circulated to the member bodies in January 1979.

It has been approved by the member bodies of the following countries:

Australia	Finland	Poland
Austria	Germany, F.R.	Portugal
Belgium	Israel	Romania
Bulgaria	Italy	South Africa, Rep. of
Canada	Korea, Dem. P. Rep. of	Spain
Chile	Libyan Arab Jamahiriya	Sweden
Czechoslovakia	Mexico	Switzerland
Denmark	New Zealand	United Kingdom

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
India
USA
USSR

Agricultural tractors – Operator's field of vision

1 Scope and field of application

This International Standard specifies practical and mathematical methods of determining the masking effects of obstructions on the angles of vision forward, to the rear and upwards of seated operators of agricultural tractors.

It does not take account of detachable implements and mounted elements, for example front loaders, pallets, etc.

2 Reference

ISO 3462, *Agricultural tractors and machinery – Seat reference point*.

3 Definition

3.1 field of vision : The area which can be viewed from the seated operator's eye position.

3.2 eye position : The specified notional location of the operator's eye (see clause 5).

3.3 semi-circle of vision to the front : A semi-circle described about a point situated in the horizontal plane of the surface below the tractor and vertically below the eye position, such that, when facing the usual direction of motion, it is situated in front of the tractor and its limiting diameter is at right angles to the longitudinal median plane of the tractor (see figure 2).

3.4 semi-circle of vision to the rear : A semi-circle described about a point situated in the horizontal plane of the surface below the tractor and vertically below the eye position, such that, when facing the usual direction of motion, it is situated behind the tractor and its limiting diameter is at right angles to the longitudinal median plane of the tractor (see figure 3).

3.5 angle of vision upwards : The angle of vision limited downwards by a horizontal plane passing through the eye position and upwards by planes containing the rays of vision from the eye position to points of obscuration caused by vehicle components other than those which cause masking effects as defined in 3.6.

3.6 masking effects : The chords of the sectors of a semi-circle of vision which cannot be seen from the eye position due to structural components, for example roof pillars, exhaust pipes, etc.

4 Accuracy of measurements

The equipment and techniques used to make the physical measurements shall be accurate to within $\pm 2\%$.

5 Eye position

The eye position shall be located 760 mm above and 150 mm in front of the seat reference point when determined, in accordance with ISO 3462, with the seat located as near as possible to the mid-positions of any vertical and horizontal adjustments and with the suspension deflected to its mid-position (see figure 1).

6 Practical method

NOTE — An alternative mathematical method for the determination of masking effects is given in clause 7.

6.1 Test area

6.1.1 The test area shall be capable of being darkened sufficiently to enable the light sources [see 6.2.1 b)] to cast distinct shadows or of being illuminated sufficiently to enable photographs to be taken or a sighting instrument to be used.

6.1.2 The area shall be large enough to accommodate the semi-circles of vision prescribed for the particular test. Preferably, it should be large enough to accommodate both semi-circles with a common centre point.

6.1.3 The surface of the test area shall be flat and smooth, with a maximum slope of 1%. The deviation from flatness caused by surface irregularities shall be limited to ± 25 mm in any 1 m length on any radial line from the centre point of the semi-circle of vision. The surface shall also be firm enough to prevent measurable penetration of the ground surface by the machine.

6.1.4 Preferably, the surface should be permanently marked out in 1 m squares.

6.1.5 Preferably, where the walls of the test area constitute the vertical cylindrical surfaces [described in 6.2.1 a)], they should be marked out in 1 m squares.

6.2 Test equipment

6.2.1 The test equipment shall include

a) vertical walls or screens, extending from ground level to a height sufficient to detect shadows at the semi-circle of vision, for example 500 mm high, having inside surfaces which are receptive to erasable marking materials or are replaceable, and comprising :

- 1) cylindrical surfaces of inside radius equal to that of the semi-circle of vision prescribed for the particular test, or
- 2) surfaces forming part of a semi-circle which can be progressively positioned in increments concentrically about the vertical axis through the eye position.

b) one or more of the following, which may be used singly or in combination, as desired :

- 1) two point sources of light, of sufficient intensity to project clear images onto the ground and onto the vertical screens or walls, and/or
- 2) a sighting instrument having two pivot axes coincident, for example a surveyor's theodolite transit mechanism, and/or
- 3) a photographic camera.

c) a firm support, to hold the light sources, sighting instrument and/or camera in two positions 65 mm apart, which can be

- 1) rotated through 360° about a vertical axis passing through the eye position, being the point midway between the light sources,
- 2) pivoted in the vertical plane to at least 45° above and below the horizontal plane passing through the light sources, and
- 3) clamped in any selected vertical and horizontal positions.

6.2.2 In order to facilitate manoeuvring the machine under test into the required position, that is with the eye position vertically above the centre of the prescribed semi-circle of vision marked on the surface of the test area, the following additional item is recommended, particularly when testing a machine without a cab :

- a plumb-bob suspended from a line running over a pulley attached to the ceiling or other rigid member situated over the test area, so that it is vertically above the centre point of the semi-circle of vision.

6.3 Tractor

6.3.1 The tractor under test shall be unloaded and unballasted.

6.3.2 The tyres fitted to the tractor shall be those recommended by the manufacturer, in new condition and inflated to the pressures recommended for road use.

6.4 Procedures

6.4.1 Angle of vision forward/to the rear

6.4.1.1 Set up the apparatus defining the eye position.

6.4.1.2 Position the tractor on the test area with the eye position vertically above the centre of the appropriate semi-circle of vision.

6.4.1.3 Locate the light sources, sighting instrument and/or camera with respect to the eye position. In the case of the camera, the reference point relative to the eye position shall be the intersection of its optical axis with the focal plane.

6.4.1.4 Adjust the support so that the line joining the two light sources is perpendicular to the line joining the eye position and a component masking the semi-circle of vision to the front or to the rear, as appropriate.

6.4.1.5 Switch on each light source in turn and

- a) record the positions and lengths of the chords denoting the presence of overlapping shadows on the vertical walls or screens;
- b) additionally, at the option of the manufacturer or if specified, determine and record obscuration of the ground plane by marking on the ground the area obscured by overlapping shadows (see figures 2 and 3).

6.4.1.6 Repeat the procedures in 6.4.1.4 and 6.4.1.5 for each other masking component.

6.4.2 Angle of vision upwards

6.4.2.1 Set up apparatus defining the eye position.

6.4.2.2 Determine the angles between the limiting planes for the angles of vision upwards (see 3.5) in four positions as follows :

- a) to the front in a vertical plane parallel to the longitudinal median plane of the tractor and passing through the eye position;
- b) to the rear in the plane of a);
- c) to the left in a vertical plane perpendicular to the plane of a) and passing through the eye position;
- d) to the right in the plane of c).

7 Mathematical method

As an alternative to the procedure set out in 6.4.1, the individual masking effects may be determined mathematically.

For binocular vision using an inter-ocular distance of 65 mm, the masking effect (X) of a component is given, in millimetres, by the following formula (see figure 4) :

$$X = \frac{r(b - 65)}{a} + 65$$

where :

a is the distance, in millimetres, between the component and the eye position, measured along the (visual) radius joining the eye position, the centre of the component and the perimeter of the semi-circle of vision;

b is the width, in millimetres, of the component, measured horizontally and perpendicular to the visual radius;

r is the prescribed radius, in millimetres, of the semi-circle of vision.

NOTE — The formula is based on the assumption that dimension c in figure 4 is equal to r .

8 Test report

The test report shall include the details in 8.1 and 8.2.

8.1 Tractor

- a) make;
- b) model;
- c) serial number;
- d) make and model of cab or protective structure;
- e) sizes and types of tyres;
- f) make and model of operator's seat;
- g) details of any other items affecting the angles of vision.

8.2 Angles of vision

a) scale drawings showing the radius of the semi-circle of vision and dimensions and relative positions of the masking effects forwards and/or to the rear;

b) if applicable, scale drawings showing the obscuration of the ground planes and including a plan view of the tractor to improve interpretation of the test data;

c) the four angles defining the field of vision upwards.

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Dimensions in millimetres

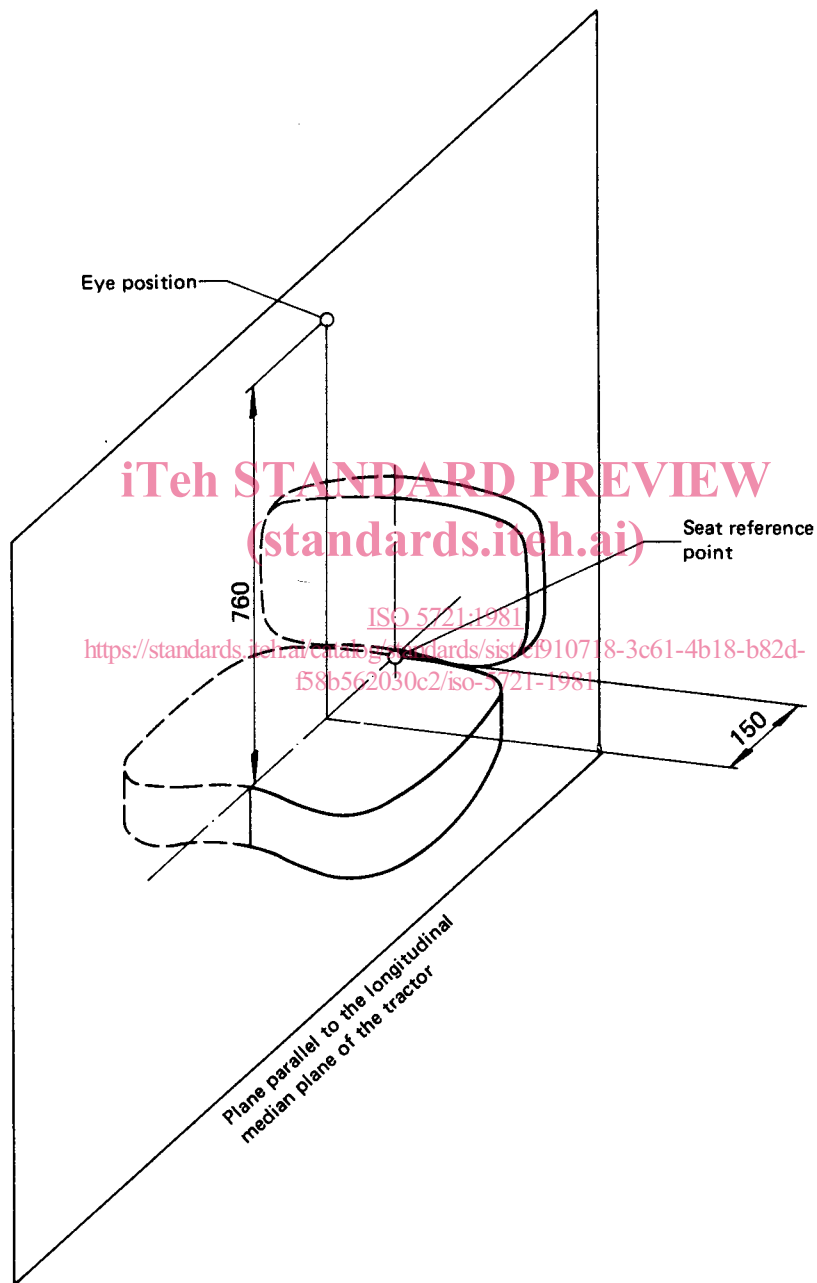


Figure 1 — Determination of eye position

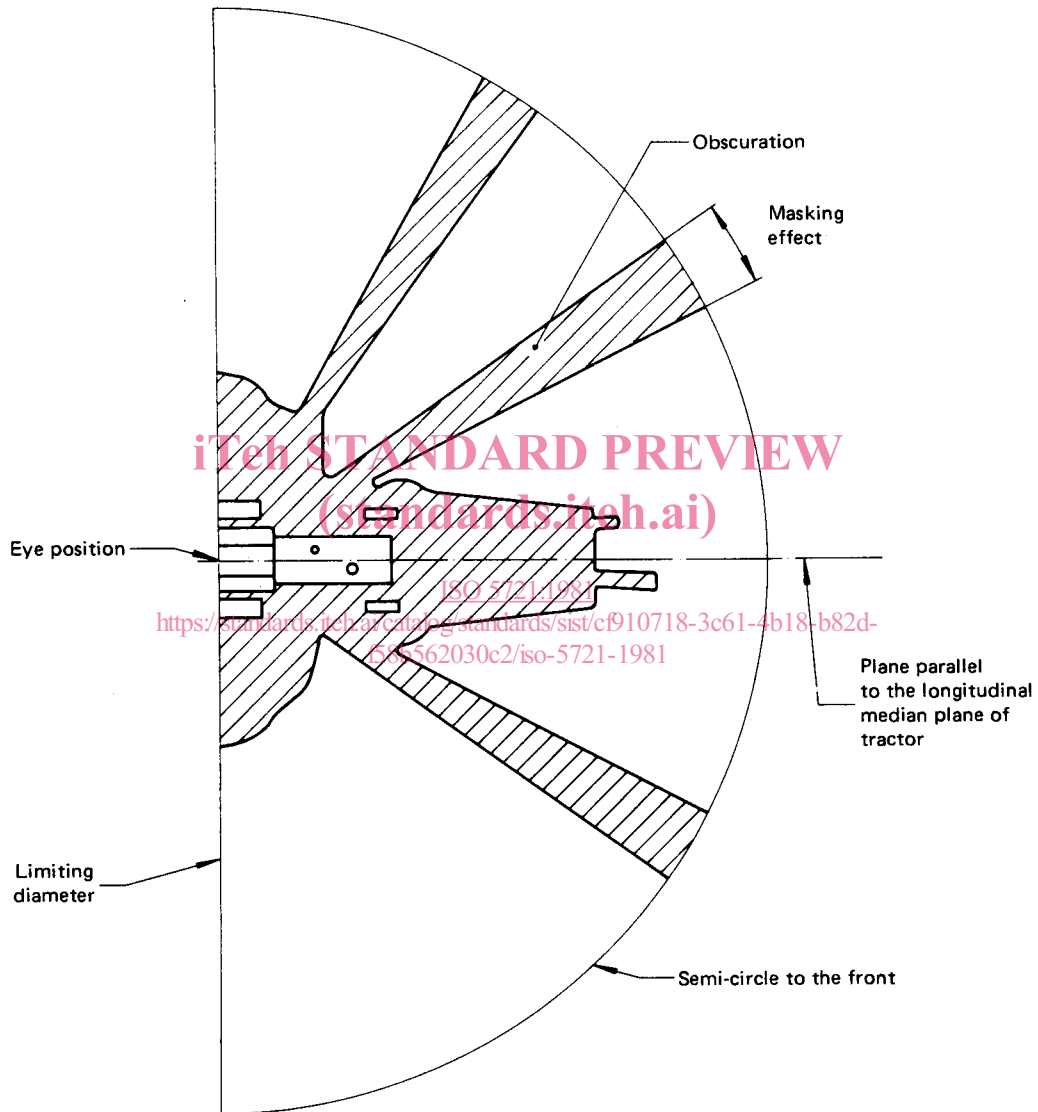


Figure 2 — Semi-circle of vision to the front (showing typical obscurations)

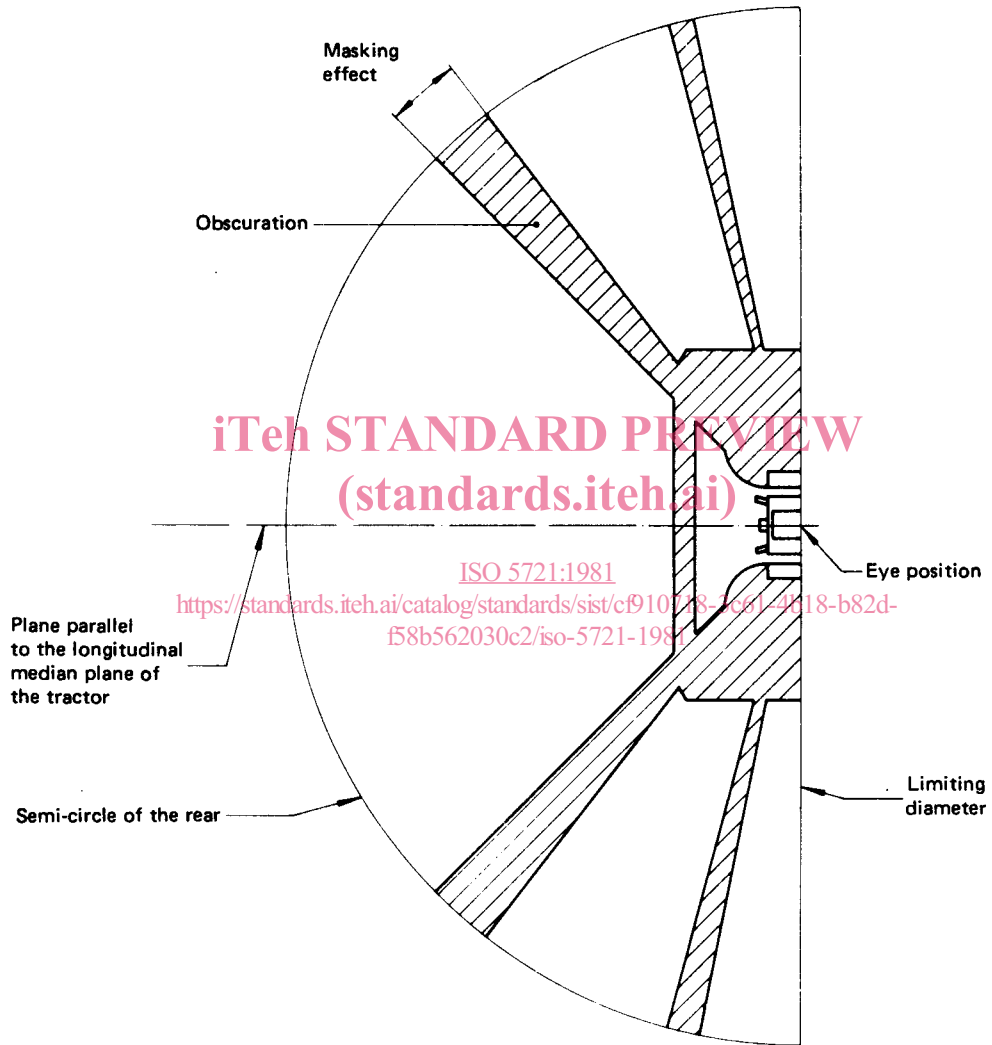


Figure 3 — Semi-circle of vision to the rear (showing typical obscurations)

Dimensions in millimetres

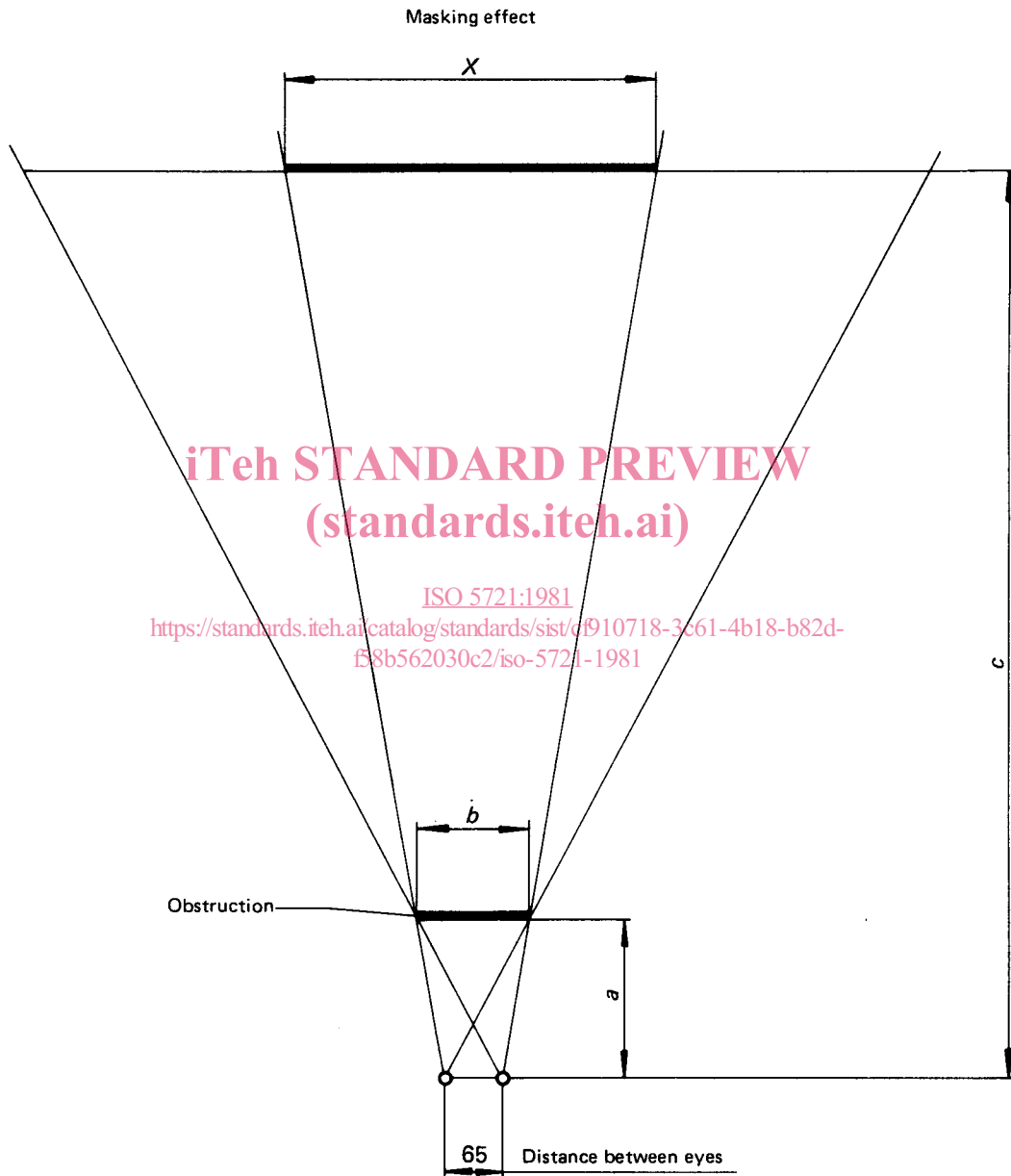


Figure 4 – Mathematical determination of masking effects