INTERNATIONAL STANDARD

ISO 16001

Second edition
2017-11

Earth-moving machinery — Object detection systems and visibility aids — Performance requirements and tests

Engins de terrassement — Dispositifs de détection d'objets et d'aide visuelle — Exigences de performances et essais

Reference number
ISO 16001:2017(E)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 1, *Test methods relating to safety and machine performance*.

This second edition cancels and replaces the first edition (ISO 16001:2008), which has been technically revised.

The main change compared to the previous edition is as follows:

— Annex G, Annex H and Annex I have been added to include state-of-the-art technologies.

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Introduction

This document outlines test procedures and sets criteria for the development of object detection systems (ODSs) and visibility aids (VAs) which indicate to the operator the presence of objects which are within the detection zone of these systems.

Proper job-site organization, operator training and the application of relevant vision standards (ISO 5006 and ISO 14401) address the safety of people on job sites. In some cases, vision of the working area cannot be achieved either by the operator's direct view or indirect view using mirrors. In such cases, operator awareness can be improved by the use of ODSs and VAs.

ODSs and VAs provide information to the operator as to whether a person or object is in the path of the machine, primarily during rearward movement.

It is essential to note that ODSs and VAs have both advantages and disadvantages. There is no device that works perfectly in all situations. It is especially important that the shortcomings of ODSs and VAs be recognized and known to system users. The advantages and disadvantages of selected devices are summarized in Annex A.

The use of a haptic signal (signal that stimulates the operator’s sense of touch, vibration, force and motion) as an alternative to the use of visual and audible signals in ODS warning devices was discussed during the revision of this document, as haptic warnings are now being used in the automotive industry. While this document does not currently allow warning devices that only use haptic signals, they can be incorporated into the warning device to supplement the visual and audible signal. More study is needed to determine the effectiveness of a haptic signal in various earth-moving machinery applications.

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Earth-moving machinery — Object detection systems and visibility aids — Performance requirements and tests

1 Scope

This document specifies general requirements and describes methods for evaluating and testing the performance of object detection systems (ODSs) and visibility aids (VAs) used on earth-moving machines. It covers the following aspects:

— detection or visibility or both of objects including people in the detection zone;

— visual, audible, or both warnings to the operator and if appropriate to the persons in the detection zone;

— operational reliability of the system;

— compatibility and environmental specifications of the system.

It is applicable to machines as defined in ISO 6165. An ODS, VA or both can be used to augment the operator's direct vision (see ISO 5006) or indirect vision using mirrors (see ISO 14401). In addition, an ODS, VA or both can be used to provide additional means of object detection or view, for example, where ergonomic considerations limit the effectiveness of direct vision and to avoid repeated turning of the head and upper body.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3411, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 6394, *Earth-moving machinery — Determination of emission sound pressure level at operator's position — Stationary test conditions*

ISO 9533, *Earth-moving machinery — Machine-mounted audible travel alarms and forward horns — Test methods and performance criteria*

ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

ISO 15998, *Earth-moving machinery — Machine-control systems (MCS) using electronic components — Performance criteria and tests for functional safety*

EN 50132-7:1996, *Alarm systems — CCTV surveillance systems for use in security applications — Application guidelines*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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3.1
object detection system
ODS
system that detects objects, including people, that are in the *detection zone* (3.3) and warns the operator

Note 1 to entry: The system generally includes a *sensing device* (3.1.1), *warning device* (3.1.2) and *evaluation device* (3.1.3).

Note 2 to entry: An ODS which operates by detection of a visual image is a *visual* object detection system.

Note 3 to entry: The system can also warn the person on the ground.

3.1.1
sensing device
ODS (3.1) component that detects a *test body* (3.4) in the *detection zone* (3.3)

3.1.2
warning device
ODS (3.1) component that transmits information to the operator or to persons in the *detection zone* (3.3) by visual or audible or both signals

3.1.3
evaluation device
ODS (3.1) component or components that analyse the signals and information transmitted from the sensing device and transform the corresponding signal to the *warning device* (3.1.2)

3.2
visibility aid
VA
system that provides indirect visibility without a *warning device* (3.1.2)

Note 1 to entry: The system generally includes one or more *monitors* (3.2.1) and *cameras* (3.2.2).

3.2.1
monitor
VA (3.2) component that provides a visual image of the *detection zone* (3.3) on a screen

3.2.2
camera
VA (3.2) component that transmits to the monitor an image of the *detection zone* (3.3)

3.3
detection zone
zone within which a *test body* (3.4) is detected by an *ODS* (3.1) or is shown by a *VA* (3.2)

3.4
test body
person or a standard measuring unit representative of a person, used to test the geometry and size of the *detection zone* (3.3)

Note 1 to entry: Depending on the system used, test bodies can be varied (see Annexes B to I).

3.5
self-checking
capability of the system to self-check continuously and immediately to inform the operator, audibly, visually, or both, of a failure

3.6
detection time
time required for an object detection system to detect the *test body* (3.4) in the *detection zone* (3.3) and activate the signal output

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