



BSI Standards Publication

**Earth-moving machinery – Object detection
systems and visibility aids – Performance
requirements and tests (ISO 16001:2017)**

National foreword

This British Standard is the UK implementation of EN ISO 16001:2017. It is identical to ISO 16001:2017. It supersedes BS ISO 16001:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/513/1, Earth moving machinery (International).

A list of organizations represented on this committee can be obtained on request to its secretary.

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Erdbaumaschinen - Objekterkennungssysteme und Sicht Hilfsmittel - Leistungsanforderungen und Prüfverfahren (ISO 16001:2017)

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European foreword

This document (EN ISO 16001:2017) has been prepared by Technical Committee ISO/TC 127 "Earth-moving machinery" in collaboration with Technical Committee CEN/TC 151 "Construction equipment and building material machines - Safety" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2018, and conflicting national standards shall be withdrawn at the latest by June 2018.

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Endorsement notice

The text of ISO 16001:2017 has been approved by CEN as EN ISO 16001:2017 without any modification.

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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).

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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.

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.

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/>

ISO 16001:2017(E)

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

3.7

stand-by

operation mode whereby the object detection and visibility aid systems are active, but no information is transmitted by the *warning device* (3.1.2) or *monitor* (3.2.1)

3.8

job-site organization

rules and procedures for managing the working together of machines and people at a job site

EXAMPLE Safety instructions, traffic patterns, restricted areas, operator training, machine and vehicle markings, communications systems.

3.9

warning range

range within the *detection zone* (3.3) in which a distinctive warning is provided to indicate the range between the machine and the object being detected

4 Performance requirements and tests

4.1 General requirements

4.1.1 Test to determine the detection zone boundary

The test shall be performed on a system that is either fitted to the machine or to a representative configuration in accordance with the appropriate annex (see [Annexes B](#) to [Annex I](#)).

4.1.2 Test body requirements

The test body requirements are specified in [Annex B](#) to [Annex I](#).

4.1.3 Evaluation of test results

4.1.3.1 Detection

Detection shall take place unambiguously with an uninterrupted sequence of the signal or information appropriate to the detection zone. For further details, see [Annex B](#) to [Annex I](#).

It is possible to combine ODSs and VAs to cover the necessary detection zone in the case where a single system cannot cover the zone.

EXAMPLE A surround view system can be combined with another object detection system, whose detection zone covers the area where the image size achieved by the surround view system is less than required.

4.1.3.2 Evaluation of false signals

False signals, such as the following, should be minimized:

- from objects outside the detection zone;
- from weather conditions of fog, snow, rain, wind, dust, etc.

4.2 Location and fixing of ODS and VA components

Components shall be located and arranged on the machine in accordance with the specification of the component manufacturer so that

- the component does not restrict any function or operation of the machine,
- the component is protected against external damage,